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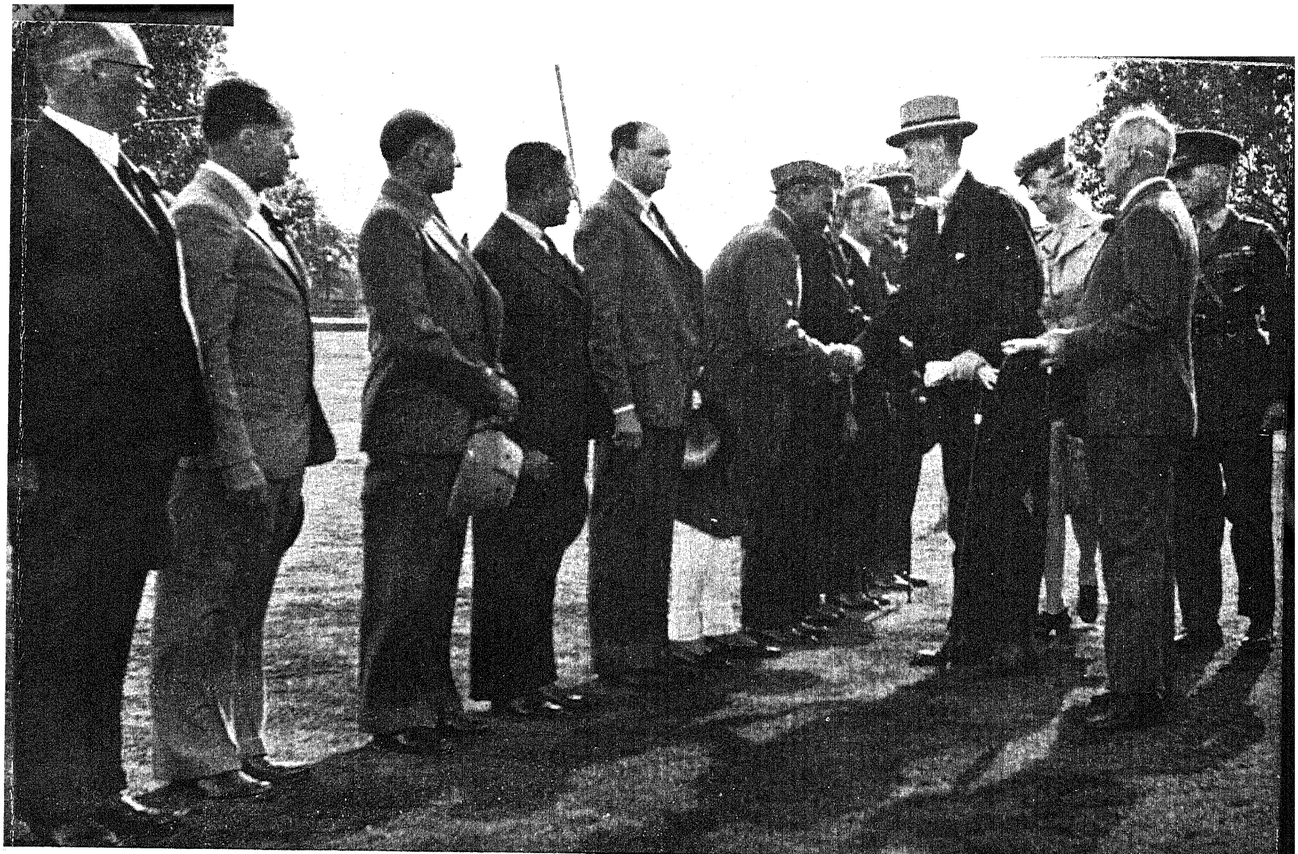

Photo Service Co.

Their Excellencies being introduced by Mr F. Ware to members of the All-India Cattle Show Committee

PLATE 46

Their Excellencies inspecting a Deoni cow from Hyderabad

Photo Service Co.

Photo Service Co.

Her Excellency at a stall, coaxing one of the animals

E 47

His Excellency the Viceroy, with Capt. U. W. F. Walker, considering the points of a Ravi buffalo.

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INDIAN FARMING

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THE ALL-INDIA CATTLE SHOW SOCIETY

AT the time they were spoken one could hardly have expected that His Excellency the Viceroy's prophetic words, delivered during his speech at the inaugural meeting of the All-India Cattle Show Society in Simla on 22 July 1939, to the effect that the Society would one day become a central organization for the exhibition at different centres of India's best breeds of cattle and buffaloes, sheep and goats, would come true so soon; but this has now come to pass and it has been accomplished this year in spite of the difficulties inherent in a country at war.

His Excellency said at that meeting: 'I am convinced that no particular line of advance offers prospects more attractive, or promises so early and so considerable an economic reward, as the improvement of cattle and their better care. Indeed, there is hardly a province or state in India where the improvement of the indigenous livestock does not hold out possibilities of incalculable increase in the total wealth of the community. Cattle shows—or more frequently cattle fairs—are a common feature of Indian life. There can be no doubt that these fairs have done much to maintain and stimulate interest in the quality of livestock in India. But the contribution that local fairs or shows can make towards breed improvement, standardization of breed characteristics and popularizing of successful types is plainly limited. What is required, if the best results are to follow, is an exhibition which presents to the interested public the opportunity of viewing at some convenient centre the best and most typical animals representing as many as possible of the famous breeds of India'.

Another authority on this subject, Dr Norman Wright, who came to India in 1937 to report on the development of the cattle and dairy industries, discusses in his report the progress made in livestock improvement in India by the usual methods and expresses the opinion that the improvement in local stock effected by the distribution of pedigree bulls has been most marked. He recommended as an 'ideal' method of effecting livestock improvement the distribution of pedigree bulls to selected areas and the registration of their progeny in those areas combined with the castration of all inferior male stock and the inoculation of all registered stock against rinderpest. It is essential, he said, that 'type' should be preserved within each breed and this will necessitate the continued maintenance of Government breeding farms where the methods of breeding can be more accurately controlled. These farm animals, it may be added, have been on show each year at the All-India Cattle Shows where they compete with the best products of the villagers, whose interest in pedigree breeding has been greatly stimulated by this form of competition.

The first All-India Cattle Show held at New Delhi in February 1938 was admittedly in the nature of an experiment, but it attracted 488 cattle and buffaloes and was considered such a success that the Government of India voted a sum of Rs. 2,55,000 to put the show on a more or less permanent footing. At

the same time the question of forming an All-India Cattle Show Society was taken up and this was registered under the Societies Act in 1939.

The second Show held from February 13 to 18, 1939, proved even more popular and was better attended than the first. The number of entries was 637 and included 22 breeds, half of which were well represented. The Sahiwal breed, the most popular milch breed in India, was alone responsible for 103 entries. It is estimated that breeders benefited to the extent of Rs. 15,000 as a result of direct sales and contracts made during this show.

The good condition and high quality of exhibits now seen at these shows affords clear evidence of the stimulus which they have given to cattle-breeding. The layout of the cattle camp, judging rings, collecting rings and stalls has now been standardized and the cattle attendants are provided with free accommodation in tents near their own animals. Arrangements are also made at each show for a veterinary dispensary, a foot bath and a segregation ward. Unlike shows in other countries, the Society's expenses increase with the number of entries, as no entrance fee is charged at present and all the animals are fed for the period of the Show at the cost of the Society.

The third Show, in 1940, placed the importance and value of an annual All-India Cattle Show beyond doubt. In spite of the prevalence of famine conditions in various parts of the country and outbreak of war, the number of entries was 706. Considerable interest was aroused by the introduction of a milking competition at the third Show. Two classes were arranged, one for cows and the other for buffaloes. Milking competitions have now become a regular feature at all the shows run under the auspices of the Society.

The number of entries for the fourth Show rose to the record number of 819 and the value of prizes offered was correspondingly increased from Rs. 10,440 in 1938 to Rs. 20,500 in 1941. A Poultry Section was added to the Show for the first time in 1941 and this innovation is being continued.

The decision to expand the activities of the Society by holding three annual shows and to add classes for sheep and goats was taken by the Executive Committee early in 1941 and the first of these series of shows has now been successfully concluded. In this connection one must acknowledge the great help which the Cattle Show authorities have received from the different Indian railways in carrying through their rather ambitious programme, which was planned at a time when the pressure on railway traffic was not so great as it is now. The exhibitors and local Governments have in their turn done what was possible to ease the situation by transporting many of their animals by passenger instead of by goods trains, often in horse-boxes, for which there is no greatly increased demand.

In spite of all the efforts made, it was not possible to obtain transport to bring all the prize-winners from the southern and western shows to compete in the All-India championships, but several of them were on view and added greatly to the interest of the final show in Delhi. As a regional show this show more than maintained its previous popularity. The complete figures for entries at the three shows held in the cold weather of 1941-42 are as follows :

	Cattle	Buffaloes	Sheep	Goats
Bhavnagar . .	362	108	80	40
Bangalore .	659	41	350	..
Delhi . .	560	150	144	113
Total .	1,581	299	574	153

Descriptions of the shows at Bhavnagar and Bangalore have appeared in INDIAN FARMING, and an account of the Delhi show is published in this issue. A perusal of these leaves no doubt that all the shows proved a marked success. The credit for this must be given in part to the whole-time officers of the Society, who had to make very strenuous efforts in order to carry through the arrangements for the three shows which followed quickly on each other, and partly, in the case of the two regional shows at Bhavnagar and Bangalore,

to the efforts of the local committee in each place and in particular to the Chairmen of those committees, viz. Mr A. P. Pattani, Dewan of Bhavnagar, and Mr T. G. Rama Ayyar, Director of Agriculture, Mysore, respectively. The Durbars of Bhavnagar and Mysore each made a special grant towards the expenses of the shows just concluded and the Society is very greatly indebted to them for their handsome contributions and also to the other provinces and states which have contributed to the Society's current expenditure. It is hoped that it will not be necessary for them to curtail their financial help even in the dark days through which we are passing, in order that this work, which has made such a good start and is so vitally connected with the welfare of the villager and India's total war effort, may be continued, albeit possibly in a restricted form.

SCIENCE AND WORLD ORDER

In closing the conference which he opened as President of the British Association, Sir Richard Gregory, that grand old man of science, put to the assembled scientists a charter of scientific fellowship :

(1) Liberty to learn, opportunity to teach and power to understand are necessary for the extension of knowledge, and we, as men of science, maintain that they cannot be sacrificed without degradation of human life. (2) Communities depend for their existence, their survival and advancement on knowledge of themselves and of the properties of things in the world around them. (3) All nations and all classes of society have contributed to the knowledge and utilization of natural resources and to the understanding of the influence they exercise on human development. (4) The basic principles of science rely on independence combined with cooperation and are influenced by the progressive needs of humanity. (5) Men of science are among the trustees of each generation's inheritance of natural knowledge. They are bound, therefore, to foster and increase that heritage by faithful guardianship and service to high ideals. (6) All groups of scientific workers are united in the fellowship of the commonwealth of science which has the world for its province and the discovery of truth as its highest aim. (7) The pursuit of scientific enquiry demands complete intellectual freedom and unrestricted international exchange of knowledge and it can only flourish through the unfettered development of civilized life.—A review of the 1941 British Association Conference broadcast by Ritchie Calder, *The Listener*, 16 October 1941.

Original Articles

ESTATE FARMING IN INDIA

III. B. C. G. A. FARM, KHANEWAL

By Sir William Roberts, C.I.E., M.L.A.

Managing Director, British Cotton Growing Association (Punjab)

In an article in *The Agricultural Journal of India* in March 1924, the writer wrote on 'Some Aspects of large-scale Farming in the Punjab'. The farm of 7,300 acres had then been worked for three years only. It has now reached its majority—21 years—and an account of some of our methods and results may be of interest.

When the farm area was taken over in 1920 certain portions were already under cultivation since 1914, but practically no levelling had been done, so that only low-lying portions could be irrigated.

Many parts of the farm area had sand hills as high as 60 or 70 ft. One sand hill occupied an area of 180 acres and even today occupies 60 acres. It took five years to clear the jungle trees and level the land. One-fifth of each square was tackled annually and tenants were given the land to be levelled free of rent or share of produce. Government also assisted colonists by remitting land revenue collections for two crops.

The whole of this remission by Government has been put aside as a separate fund for development work and assistance to tenants. The lambardari fee paid annually by Government for collecting the land revenue is also paid into this fund which stands at Rs. 50,000 at present.

Scheme of rotation

The annual rainfall at Khanewal averages five inches per annum; so our crops depend almost entirely on canal water. The whole area is divided into squares of 25 acres, as is all the irrigated land on the Lower Bari Doab Canal where the farm is situated. The five lines of five acres each in every square is further divided by us into two, thus making 10 lines of $2\frac{1}{2}$ acres per square. Irrigation channels or watercourses flow between each five-acre line. The rotation is roughly a three-year one of wheat, fodder, cotton with four lines of wheat, three of fodder or fallow and three of cotton. If in any one year cotton comes on lines 4, 5, and 6 in one square, it will be in the same lines in other squares so that often there is a length of 8 or 10 squares or two miles of cotton $\frac{3}{10}$ of a square wide. The fodder area will be similarly in continuous lines, say 1, 2 and 3. The irrigation water can thus be made to travel always in the crop and rarely over fallow land. It is estimated at least 15 per cent of the water leaving the Minor is lost in watercourses; so this tends to minimize the loss.

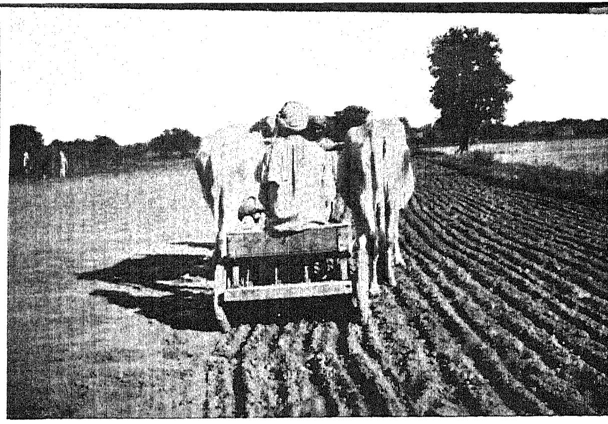
A further saving is effected by puddling the water channels with a sludge of bicarbonate and *bhusa* as recommended by Dr McKenzie Taylor of the Irrigation Research Institute, Lahore. In this way the best use possible is being made of every drop of irrigation water that is available.

All our crops such as cotton and wheat are sown in lines and intercultured either with a Gujrat hoe costing Rs. 8 or in the case of wheat by a Bar harrow costing Rs. 10. This also tends to save waste of water by evaporation and keeps weeds down. The latter can only flourish at the expense of the crop and is therefore the deadly enemy of the farmer.

Manure pits

At the point where four squares meet, i.e. in the centre of every 100 acres, we have a plantation of $\frac{1}{8}$ acre consisting of *shisham* (*Dalbergia sissoo*) and *kikar* (*Acacia arabica*).

Ploughing with Rajah plough



Sowing wheat by Johnston drill

Wheat harvesting

PLATE 48

American cotton

Cotton picking

The idea is to encourage the tenants to keep the cattle on the land rather than in the villages. The manure is stored in pits and all refuse available is added to it. Seventy such glades of trees are flourishing at the farm and serve as sources of timber for implements and house repairs. At the villages themselves a large-scale manure pit factory is in operation on the Indore lines. Except for about 12 squares, the whole area is under tenant cultivation on the *batai* (half-share) system. Some $\frac{1}{2}$ seer per maund is taken from the common heap at harvest time to pay for medical relief, education, payment of midwives, etc. and is being appreciated. Half the cost comes from the tenants and half from the landlord.

Ploughs, harrows and other iron implements are kept at village headquarters and loaned out as required to the tenants. Iron ploughs are used at least once a year on all cultivated land.

Owing to the damage done by *tirak* or bad opening, our date of sowing for cotton has tended to become later and later. We used to sow in early April but now the best date is 10 June and sowing starts 10 days earlier and continues up to 25 June. Picking of American cotton starts in early November and is finished by the end of January.

Origin of N T cotton

The farm has been used extensively to test on a large scale new varieties of wheat and cotton. In the case of cotton the farm had a major share in introducing 289F cotton of which a few ounces only were brought by the writer from Mr Milne's selections at Layallpur in 1921. All subsequent long-staple types in the Punjab and Sind of the N T class are derived from this original seed. The most successful of all is a type selected at Khanewal Farm by Mr Roger Thomas eight years ago and now grown over two lakhs of acres in the Punjab and a lakh of acres in Bahawalpur and Sind. The total production of 289F types today is not less than four and a half lakhs of bales and the area under it probably 1,000,000 acres in the Punjab, Bahawalpur and Sind.

With Khanewal as a centre and applying the principles worked out here we have taken large areas on lease in the Punjab, Bahawalpur, Sind and Baluchistan and now control over 200,000 acres of irrigated land, and operate besides thirteen ginning and pressing factories and two large oil mills.

Seed for the Agricultural Department in the Punjab and Bahawalpur and for cultivators in Sind is supplied for well over $2\frac{1}{2}$ lakhs of acres of cotton and about a lakh of acres of wheat every year.

Our average yield of cotton for the last two years has been $12\frac{1}{2}$ maunds of $82\frac{2}{7}$ lb. and of wheat 20 maunds per acre. Our highest average yield of cotton has been $15\frac{1}{2}$ maunds and of wheat 22 maunds.

Social welfare

The houses put up first were rough and ready, though the four villages of the farm were carefully laid out and trees planted along all roads. We have recently been reconstructing tenants' houses according to a regular plan. Nearly half the houses have been rebuilt in this way and it is hoped to complete the work in three or four years more.

A visiting doctor is employed and a dispensary established at the headquarters village. An average of over 40 patients a day are treated at the dispensary.

As the mortality among children and in childbirth was high, we started training midwives six years ago and have now trained twelve altogether.

We are now starting a fund contributed to equally by us and by the tenants for welfare work. Sir Chhotu Ram deserves credit for the idea which originated from him when he was Minister of Agriculture.

The tenants will virtually control the expenditure of this fund, though the Farm Manager retains the right of veto. This fund is being registered to ensure that the whole of it will be spent for the benefit of the tenants only.

RABIES AND ITS CONTROL IN INDIA

By M. R. Sharma, L.V.P., P.V.S.

Deputy Superintendent, Civil Veterinary Department, Delhi Province

In Charge, Civil Veterinary Hospital, New Delhi

RABIES is one of the oldest known diseases. It is found in nearly all parts of the world and in all climates. It has not so far been introduced into Australia or New Zealand and has been stamped out of the British Isles by the destruction of all animals infected with the disease, or suspected to be so infected, by the muzzling order, and by strict quarantine regulations concerning the import of dogs. Once the symptoms have developed, it ends fatally almost always. It is also a source of imminent danger to human life and domestic animals, causing considerable economic loss.

To apply suitable measures of control against this disease it is essential, as in the case of many other diseases, to have a thorough public awakening.

Rabies is primarily a disease of wild and domesticated canines, e.g. dogs, jackals, foxes and wolves, but all the warm-blooded animals like cattle, horses, goats, sheep, cats, monkeys, rabbits, camels, elephants, fowls and human beings are susceptible. Infected canines, particularly pariah dogs, so widely and extensively distributed in India, spread the disease among themselves and other susceptible animals and human beings. The mongoose and blood-sucking (vampire) bat have been reported to act as a natural reservoir of rabies virus in South Africa and South America respectively and to convey the infection to domesticated animals and human beings ; but in India the virus is usually maintained by wild carnivores and stray dogs.

Cause

The causative agent of this disease is a virus which passes through bacterial filters and is not visible even with the aid of the microscope. Desiccation, heat, sunlight and antiseptics adversely affect the virus, but glycerine acts as a preservative, as is the case with most of the viruses. The virus is destroyed by exposure to a temperature of 60°C for half an hour or by the ordinary disinfectants.

With the bite of an infected animal the virus which is present in the saliva, even 10 days before the onset of the symptoms, is injected into the victim. The quantity of the virus thus injected depends upon the depth and number of bites and presence or absence of clothes and hair covering the skin. Crushing of soft tissues caused by the bite of a rabid dog produces a favourable environment for the propagation of the virus and its penetration into the nerve trunks and transmission to the brain and spinal cord. Besides saliva, the urine of a rabid dog is also infective. Rarely may the disease be acquired by infective saliva or urine coming into contact with the eye. The virus of a natural case produces inconstant results and is called 'street virus' to distinguish it from its modified form known as 'fixed virus' which is obtained by serial passage through rabbits and produces constant results in them on inoculation. The latter is chiefly employed in the manufacture of vaccines.

Symptoms in dogs

After the introduction of the virus into the tissues of the victims, some time must elapse before the symptoms of the disease appear. This period, known as 'the period of incubation', varies with the species, site and character of the bite, and the quantity and virulence of the injected virus. It usually ranges from 15 days to 6 months in dogs, 15 to 60 days in cats, 10 to 45 days in horses, 14 to 60 days in sheep and pigs and 14 to 64 days in human beings. Cases are on record of much longer periods extending even up to two years. It is shorter in young animals and also when infection has taken place near to the head.

As the virus affects principally the nervous

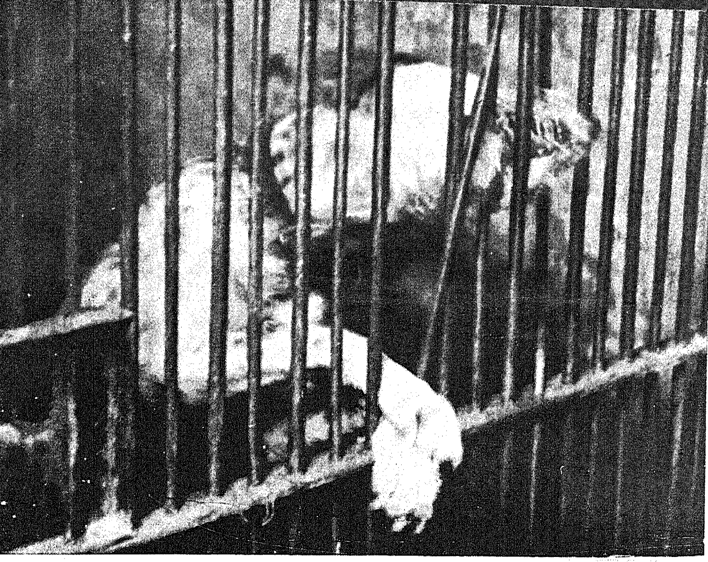


FIG. 1. Left: A case of 'furious' rabies

FIG. 2. Right: A case of 'dumb' rabies

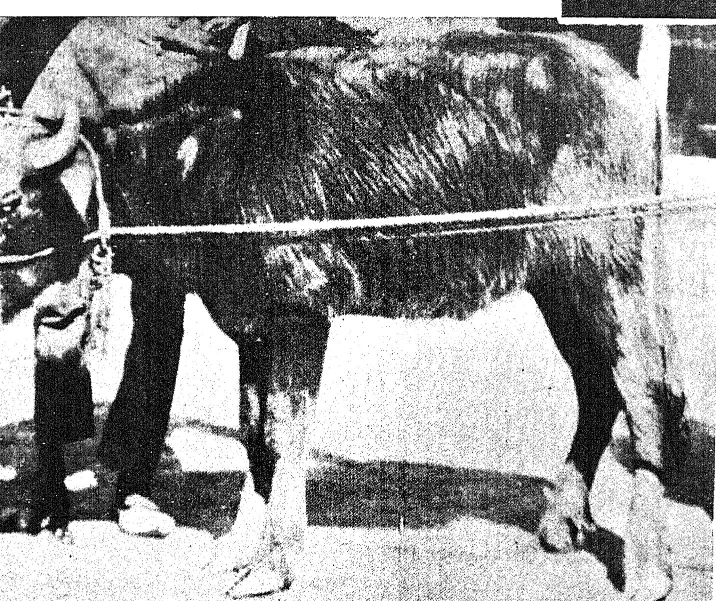


FIG. 3. Left: A rabid buffalo calf
(after S. H. Gaiger)

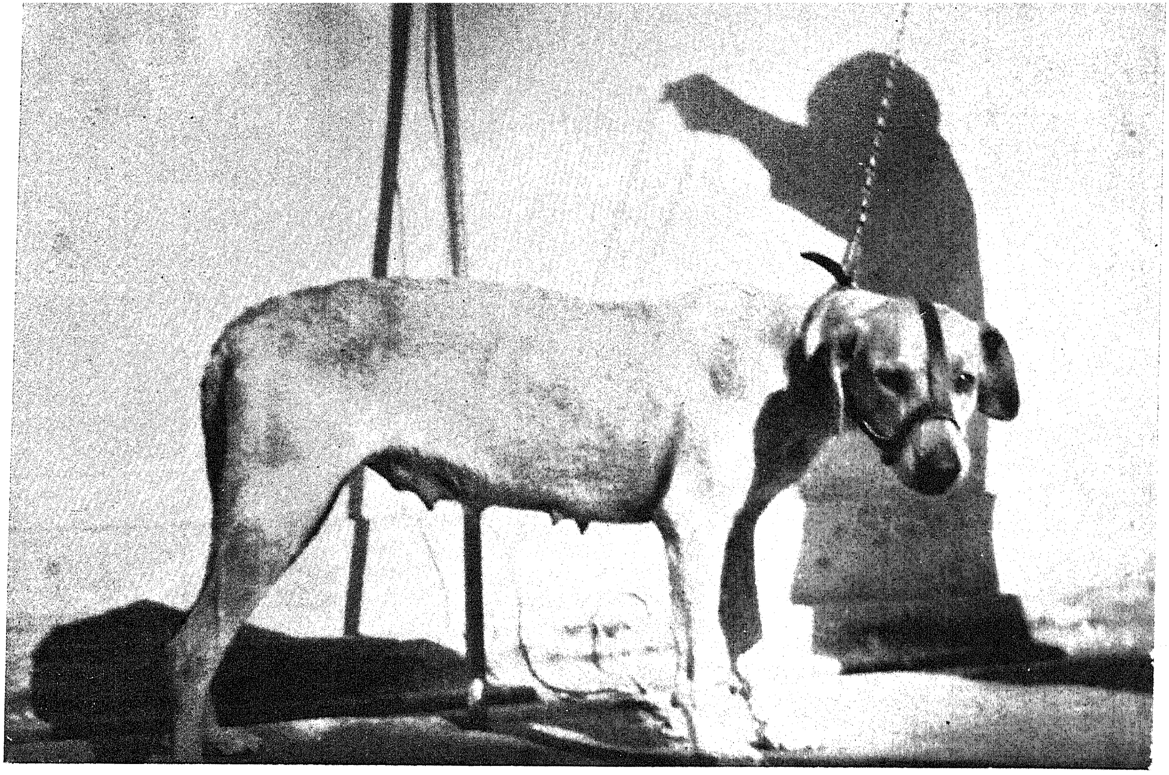


FIG. 1. A muzzled dog

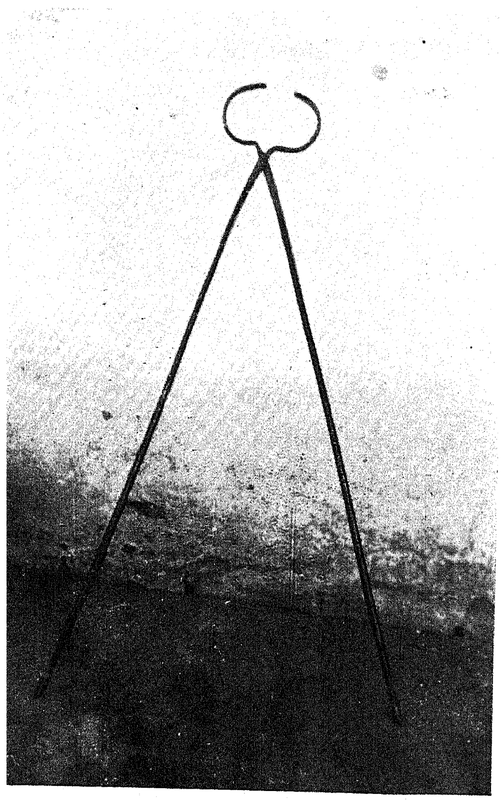


FIG. 2. A suitable dog catcher

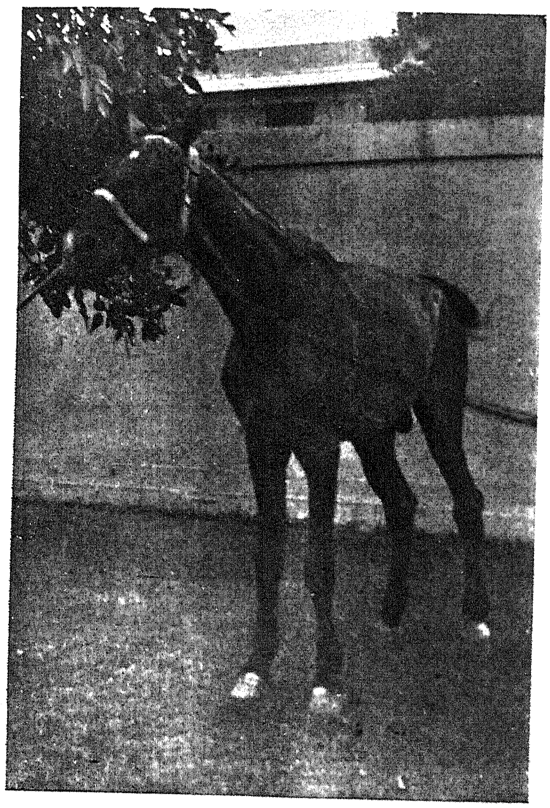


FIG. 3. A rabid pony showing the onset of paralytic symptoms

system, the symptoms are associated with nervous derangement. In a typical case three characteristic stages of melancholy, excitement, and paralysis are observed. But in dogs one should not expect all the usual symptoms to be present in each case. In some cases, particularly of small pet dogs, the stage of excitement is usually so short as to pass unnoticed, and paralysis, especially of the jaw and hind limbs, sets in early (dumb rabies). In others, especially dogs of larger breeds, the stage of excitement is very pronounced and the ultimate paralytic symptoms are delayed (furious rabies). However, there is no fundamental difference between the two forms.

In the preliminary stage usually there is some alteration in disposition or habits. There may be unusual display of affection or the animal may turn morose, hiding under furniture or in corners and not usually responding to the owner's call. The eyes have a vacant look and the pupils are dilated. There is mental delusion and the animal snaps at imaginary objects, becomes restless, with a tendency to start at the slightest sound. Salivation is increased and the appetite becomes morbid, refusing ordinary food, but eating straw, wood, carpets, leather, stones, etc. There is a characteristic change in bark and there may be a rise in temperature and sometimes constipation. This stage usually lasts about two days and the animals may then develop either of the two forms mentioned above.

In the ' furious ' form the animal will try to bite anything within reach such as its chain, metal bars, or the woodwork of the cage, thereby causing injuries to its mouth (Plate 49, fig. 1). If the animal is loose, it runs about aimlessly for miles, biting anybody coming in its way, and may engage in fights with pariah dogs, thereby spreading the infection. Salivation and mental delusion are increased. There is great desire for water and the animal is unable to bark well and the voice is somewhat between a howl and a bark. Later on, in the aggressive stage, the animal may even become dumb and attack others in silence. Appetite is usually suppressed and the animal bites its own body. In about three to four days paralysis sets in, affecting the jaw and limbs. The dog loses the power, but not the desire to bite. One has not to wait long to see the end of the affected dog, which occurs in seven or eight days unless it dies earlier due to exhaustion.

In the ' dumb ' form the preliminary stage of melancholy is comparatively short, and is soon followed by signs of paralysis, there being practically an omission of the ' furious ' stage. The jaw muscles and the tongue are first to become paralysed with the result that the lower jaw drops, the animal cannot feed and salivation increases. There is no desire to bite, paralysis gradually extends to the hind and then to the fore limbs. (Plate 49, fig. 2.) The dog becomes comatose and dies in two or three days.

Other domesticated animals

The symptoms described above are more or less common to other domesticated animals which usually get the infection through the bite of a rabid dog. Affected cattle show general uneasiness, disposition to do damage, straining, stamping, bellowing, frequent attempts at micturition, sexual excitement and dribbling of saliva. This results in exhaustion and great loss of condition followed by paralysis of the hind and fore limbs. In some cases the excitement stage is short and paralytic symptoms appear earlier. Death usually results within five days of the onset of the symptoms. Similar symptoms are observed in affected goats, sheep and swine. During excitement they become aggressive and attack practically any class of animals, even dogs. An affected horse becomes excited and aggressive, walks round his stable, dribbles from the mouth, and very often bites his own body, especially the site of infection. The writer has met with two such cases, wherein the history and symptoms given by attendants were such as to give all reasonable suspicion of colic. But on a careful examination, both the cases were found to be of rabies. So one should always be very careful in handling any suspicious cases like these. There is increased sexual excitement and frequent micturition. Thirst is marked, although there may be some difficulty in swallowing. The excitement stage results in paralysis affecting the throat and hind limbs.

In fowls, the bird shows signs of conspicuous fright and unrest. It runs in circles with ruffled feathers, frightened look and hoarse cries, attacks the healthy birds and even human beings with the beak. Ultimately paralysis sets in, followed by death.

Hydrophobia

In man three stages of the disease are recognized. The first stage is of general malaise which is characterized by pain at the site of infection even if the wound is healed up, stiffness of the limbs and joints, rise of temperature, headache, general uneasiness and disinclination to drink. The patient does not sleep well and experiences spasms in the throat when he tries to swallow. This gradually passes on to the second or hydrophobic stage during which the spasms increase and become extremely severe even at the sight, or suggestion of water. There is actually fear of water (hydro-phobia). There is increased salivation and nervous irritability, accompanied by screams, fits of madness and convulsions. Sometimes the patient becomes aggressive. This causes rapid emaciation and passes on to the third or paralytic stage during which general paralysis and respiratory distress due to paralysis of the diaphragm are observed. This stage is of short duration and is very soon followed by death. The writer saw a case of rabies in a child about 11 years of age in the winter of 1940. The child developed rabies, even after going through a course of anti-rabic treatment immediately after the bite and showed all the typical symptoms of the disease.

Diagnosis

The usual history of a bite from a dog and the presence of a bite wound in addition to the symptoms mentioned above, should enable one to identify a case of rabies. It is advisable not to destroy a suspected case of rabies but to keep it under observation in a suitable isolated place and allow the disease to take its natural course. This assists in arriving at the correct diagnosis. A rabid animal almost invariably dies within 7 to 10 days from the onset of symptoms. To catch a rabid dog alive, especially a furious case, with minimum risk is a difficult problem. For this the use of a suitable catcher (Plate 50, fig. 2) is recommended.

In the carcase of a rabid dog one may find signs of salivation, soiled tongue, injuries to the mouth and even broken teeth, resulting from biting at and ingestion of foreign bodies. These may be found in the stomach which may show haemorrhages. The feet may show signs of the animal having travelled long distances. However, to arrive at a definite diagnosis it is essential to send the brain of a suspected animal for microscopic and biological examination to the Pasteur Institute, Kasauli, or some other laboratory doing similar work. Only a veterinary surgeon should undertake the removal, preservation and despatch of the brain of a suspected case. In microscopic examination a positive diagnosis is based on the presence of peculiar structures known as 'negri bodies', which are found in certain parts of the rabid brain. Although a positive diagnosis by this method is reliable, a negative diagnosis is not necessarily correct and in such cases, one should rely entirely on the clinical diagnosis given by the veterinary surgeon. The results of biological examination depend upon the ability of the suspected brain material to infect rabbits, which develop the paralytic or 'dumb' form of rabies without showing any furious symptoms and die within 27 and 10 days from the date of inoculation in the case of 'street virus' and 'fixed virus' respectively. To wait for 27 days for the results of a biological test for recommending anti-rabic treatment of human beings or pet animals exposed to bites from or contact with an animal suspected to be rabid is extremely risky. On the slightest suspicion of rabies, it is advisable to recommend their vaccination without waiting for the results of the laboratory tests.

Similarity to other diseases

Although the disease may be confused with nervous diseases like epilepsy and hysteria in dogs, encephalomyelitis in horses and cattle, the history and the symptoms described above would enable one to differentiate these conditions without much difficulty. In epilepsy and hysteria the attacks are repeated and not

continuous, and the animal does not die in eight or ten days from the onset of the symptoms. Mechanical injury to the jaw may cause dropping of the jaw, similar to that seen in rabies, when the jaw is paralysed. Foaming at the mouth and frenzy caused by a foreign body in the roof of the mouth should always be handled with due precaution, as the existence of a foreign body in the mouth does not exclude the possibility of rabies, but on the contrary it increases the suspicion. There are certain other conditions like the nervous form of canine distemper, intestinal worms, foreign bodies in the rectum, which may produce certain nervous symptoms resembling those of rabies, but an experienced veterinary surgeon would find no difficulty in differentiating these conditions from rabies.

Prevention and control

Rabies is primarily a disease of dogs, which spread the infection to other domesticated animals and human beings by means of their bites, and again it is the dog that while fighting or hunting wild animals like wolves, jackals and foxes brings the infection, although these wild animals may sometimes directly bite human beings and domesticated animals in the jungle. Therefore the control of the disease lies principally in controlling it amongst dogs. Complete eradication of the disease from India, where it is widespread, is perhaps impossible on account of geographical difficulties and the presence of wild carnivores and innumerable stray dogs which would keep the virus alive.

An attempt should be made to minimize the chances of the spread of the disease by the destruction of ownerless dogs, licensing of other dogs at least in municipal areas and restriction of the liberty of dogs unless muzzled (Plate 50, fig. 1) to premises of the owners. To judge what can be achieved by the muzzling order one has only to glance at the statistics of Great Britain. Muzzling was begun in 1890, and the cases of rabies went down from 129 to 38 in 1892. When in response to public feelings the orders were relaxed, the result was that cases rose from 93 in 1893 to 672 in 1895. In 1895 the muzzling order had to be reinforced with the consequence that incidence of the disease went down, until between 1903 and 1907 no case of the disease was reported. It was about 1933, when the writer was working in Simla, that a great number of cases of rabies occurred there among dogs. The writer recommended the enforcement of the muzzling order and the results were most satisfactory. Free prophylactic vaccination of dogs with a suitable vaccine once a year, preferably at the time of issuing licenses, should also be introduced. With these measures the disease can be effectively controlled and its incidence immensely diminished in this country. Expenditure on prophylactic vaccination of dogs would be amply compensated by reduction in the cost of anti-rabic treatment of human beings. Unwanted pups should also be destroyed and the destruction of wild carnivores such as jackals, wolves, and foxes should be encouraged as far as possible. Bitches in season should not be let loose, so that dogs do not assemble and engage in fights facilitating the spread of infection. All dogs in contact with or bitten by a rabid dog and those newly imported into a locality should be muzzled and kept under proper control for a period of six months even if anti-rabic treatment is given.

Destruction desirable

It is highly desirable to destroy all animals bitten by rabid dogs and to discourage curative vaccination, particularly when the animal is badly bitten, especially round the head as such dogs may develop rabies even if vaccinated and may thus be in an infective state before the completion of the process of immunization and therefore a source of danger to the owner, his family and attendants. Sometimes infection with a more highly virulent strain of virus cannot be suppressed by vaccination. The treatment thus creates a false sense of security. If in the case of valuable pet animals, it is desired by the owner to have anti-rabic vaccination carried out in spite of the above-mentioned risk and expense, it is necessary that the bite should be thoroughly disinfected and cauterized. The vaccination (curative) may be carried out at the nearest veterinary hospital with a vaccine issued by the Pasteur Institute or any Government veterinary Institution in India. The usual time available for treatment after

infection varies from 17 days for individuals bitten on the head to a period of two or three months for bites on the lower extremities. During this incubation period of 'street virus' active immunization with 'fixed virus' incorporated in the vaccine should be carried out with a view to aborting the infection. It is curative in the sense that it extinguishes the infection. The sooner this protective vaccination is undertaken after exposure to infection the greater will be the chances of success.

It should be made legally binding on the owner or person in charge of the animals infected with rabies or suspected to be so infected to report the matter to the local veterinary or public health officers. It is necessary that the carcases of all such animals should be properly disposed of either by cremation or deep burial with a layer of lime, and the premises, fittings, utensils, etc. should be thoroughly disinfected.

Preventive vaccine

The prophylactic or preventive vaccine referred to above is of the greatest importance in the control of this disease in a country like India, where it is widespread. The experience gained in this method of control by other countries where similar conditions exist is worth mentioning here. In Japan, out of approximately 260,000 dogs vaccinated by the method of Umeno and Doi, only 169 contracted the disease during the year following vaccination, while 5,881 cases occurred among the unvaccinated dogs. It has further been shown that a significant decrease has occurred in the number of persons bitten and in the number of deaths from rabies after systematic vaccination by this method. Similar claims with regard to the reduction of the incidence of this disease by use of this vaccine have also been made by workers in the U. S. A.

In selecting a suitable vaccine one should see that it is

(1) Efficacious (early conferment of durable immunity after vaccination).

(2) Safe (properly attenuated, producing no injurious effects such as the development of the disease or post-vaccinal paralysis, etc).

(3) Easy to manufacture.

(4) Easy to use (one-dose vaccine preferable to others).

(5) Of fairly long keeping quality (to enable transhipment in a potent state, from the place of manufacture to far-off places).

Umeno and Doi's single-dose vaccine (glycerinated carbolized) referred to above fulfils these conditions, but its manufacture and quality have yet to be tried in India, using the local strain or strains of the virus and with such modifications as may be necessary to suit local conditions. In the absence of this vaccine the following vaccines which are available in the market and have been extensively used by the author with satisfactory results are recommended :

1. *Anti-rabic vaccine prepared at the Central Research Institute, Kasauli.*

The oldest method is that of Pasteur which consists of a number of injections, usually seven, with a 6 per cent brain emulsion prepared from sheep's brain with $\frac{5}{8}$ per cent carbolic. The writer has used this method both as curative and prophylactic for years with encouraging results. Post-vaccinal paralysis has been reported in certain cases by others, but I have never come across one in my many years' experience. The immunity lasts for six months.

2. *Mulford's rabies vaccine prepared in America.*

It is a chloroform-killed rabies vaccine containing $33\frac{1}{3}$ per cent of rabid brain and cord tissue. This is a single-dose treatment and the immunity is claimed to last for a year. The writer has carried this out on a large scale for years with very good results.

3. *Anti-rabic vaccine prepared at the Punjab Veterinary College, Lahore.*

It is a simple and suitable vaccine prepared from an emulsion of a rabbit's brain and consisting of a 2 per cent brain emulsion in normal saline with carbolic acid.

HOW *TIRAK* AFFECTS PUNJAB-AMERICAN COTTONS

By R. H. Dastur

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THE Punjab-American cottons in the Punjab suffer from a physiological disease popularly known as *tirak* or bad opening of the bolls. The cotton crop which is generally sown in May appears healthy and normal up to September when the crop is in its flowering phase. The symptoms of this disease first appear in the leaves which begin to turn pale green and yellow. This is followed by reddening and shedding of the leaves. The bolls of such plants remain small and crack prematurely, i.e. before their normal period of maturation (52 days) is completed (Plates 51 and 52). The cotton seeds in such bolls are partially or fully immature and bear very trashy lint. The lint does not fluff out of these bolls as in the case of the normal bolls (Plate 52). The percentage of oil in seeds from such bolls is much lower than in the seeds from normal bolls. The weight of *kapas* per boll is therefore considerably lowered. Normally 400 to 500 bolls are required to yield one seer (2 lb.) of *kapas* while any number from 600 to 2,000 bolls, depending on the intensity of the disease, are required to yield the same quantity of *kapas* when *tirak* occurs. The general level of cotton yields in such fields is therefore lower than what it would be if the crop was not subject to this trouble. A field that would normally yield 800 lb. of *kapas* per acre may give even as low a yield as 150 lb.

Enormous losses caused

Tirak in very intense form occurred in 1921, 1926 and 1928 and the yields of *kapas* per acre for the province were reduced to about 3 maunds per acre in these years, the general average yield being about 5·2 maunds. These years were named as years of partial failure of the American cottons in the Punjab.

The extent of loss suffered on account of this disease can be judged from the total acreage under American cottons in the Punjab. The acreage under these cottons fluctuates from one to one and a half million from year to year and a depression in yield of even one maund per acre would cause great losses to the zemindars. The Punjab Government, therefore, with the financial assistance of the Indian Central Cotton Committee, undertook intensive research on this important problem with a view to determining the causes of *tirak* and remedying it, even to a small degree, if possible. These investigations began in March 1935 and, though they are still in progress, the knowledge so far gained as a result of work done during the last five years is here briefly summarized.

Preliminary observations made in the early stages of this investigation paved the way to the discovery of the causes of this physiological disorder. (1) Microscopic examination of the leaves of *tirak* plants showed the accumulation of a chemical substance in their tissues. (2) *Tirak* was found to occur, in many cases, in the same field every time cotton was grown there. It was also observed that the cotton crop showed *tirak* in one part of the field while the crop was normal in another part of the same field. The intensity and spread of *tirak* in a field were also found to vary in different seasons.

Nitrogen deficiency

The first observation led ultimately to the discovery of nitrogen deficiency in the plants that showed the symptoms of *tirak*. The deficiency of nitrogen in plants generally occurred in light sandy soils and the crops on such lands showed these symptoms. The second set of observations led to the discovery of the presence of sodium salts in abnormal amounts in the subsoil at a depth of two or three feet from the soil surface. Thus two

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types of soils were found to be associated with *tirak:* (1) light sandy soils with nitrogen deficiency, and (2) sandy loams with salinity in the subsoil. It was later found that light sandy soils deficient in nitrogen were at the same time saline in the subsoil and the worst form of *tirak* occurred in such fields. The soils under normal and healthy crop were neither saline nor did they produce a deficiency of nitrogen in the plants during the fruiting stage.

As the work progressed, it was discovered that normal soils, soils with saline subsoil and soils deficient in nitrogen were, many a time, found intermingled in a small area measuring about $2\frac{1}{2}$ acres or less. Consequently a great deal of confusion was caused in correlating the soil conditions with the normal or the abnormal behaviour of the crop.

Light sandy soils

The cotton soils in the Punjab contain large amounts of sand and small quantities of clay. The percentage of sand in light sandy soils is nearly 70 in the upper surface. Under normal conditions of irrigation which ensure a regular supply of water and with long and bright summer days which are favourable for the food-manufacturing processes of the leaves, the American cotton plants make rapid growth. The nitrogen in the soil is adequate for the vegetative growth of the plants and the crop therefore shows no symptoms of *tirak* till the regular flowering phase sets in at the end of August. At this stage the demand for nitrogen becomes high as it is needed for the production of flowers and fruits and it is not met from the soil. The nitrogen present in the leaves travels towards the fruiting parts and the leaves get depleted of its nitrogen as it is not replenished by absorption from the soils. The loss of nitrogen causes senility of the leaves which turn yellow and are shed. When the leaves are shed other non-nitrogenous food substances and minerals are also lost to the plants.

The analysis of the leaves in the month of September from such fields show that their nitrogen content has fallen to 1·5 per cent or less which is much below the amount found in the leaves of the normal plants. The level of nitrogen in the leaves should not fall below 2·5 per cent during the fruiting stage for proper maturation of the bolls.

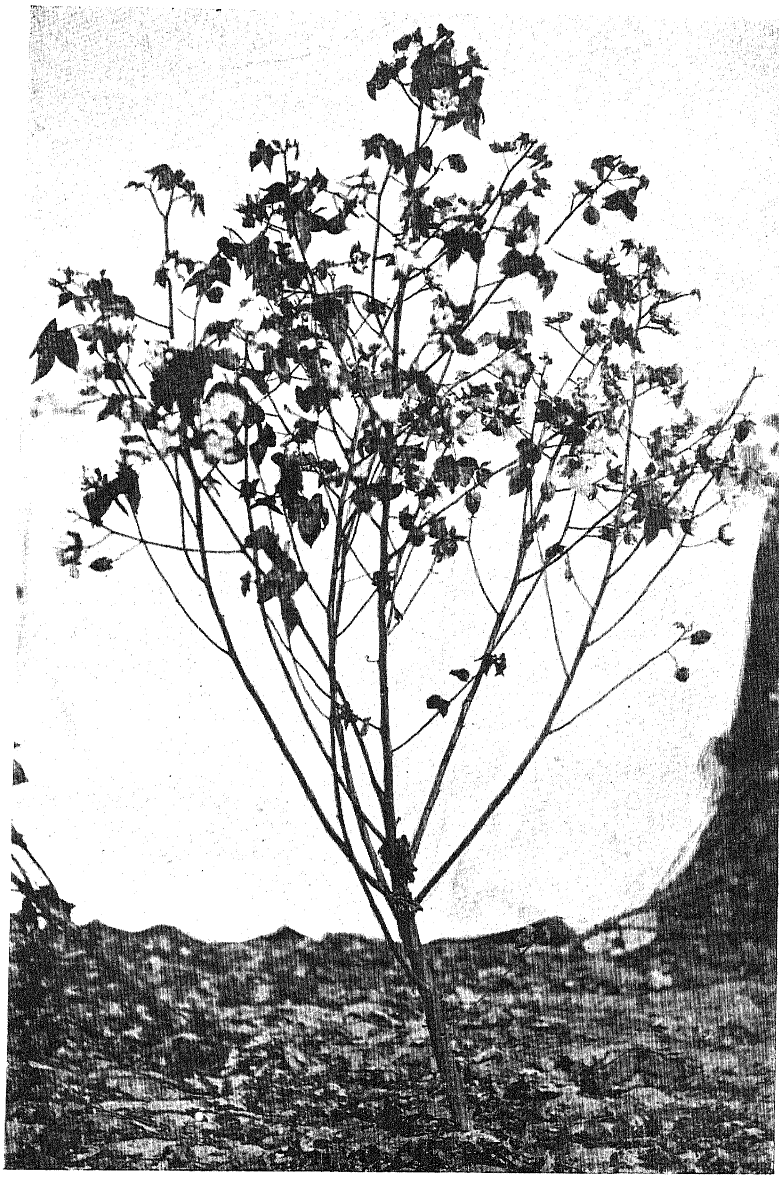
When the nitrogen contents of the leaves fall below normal, an organic substance known by the general name 'tannin' is found to accumulate in their tissues. The accumulation of tannins produces other disorders in the plant. This substance was first noticed in the tissues of the leaves under the microscope and later it was found to be a biochemical index of a deficiency of nitrogen in the plant.

The low nitrogen level, the production of tannins in the tissues and the premature senility and loss of leaves cause poor development of cotton bolls. The seeds therefore remain partially immature. The final result is *tirak* or poor opening.

Soils with saline subsoil

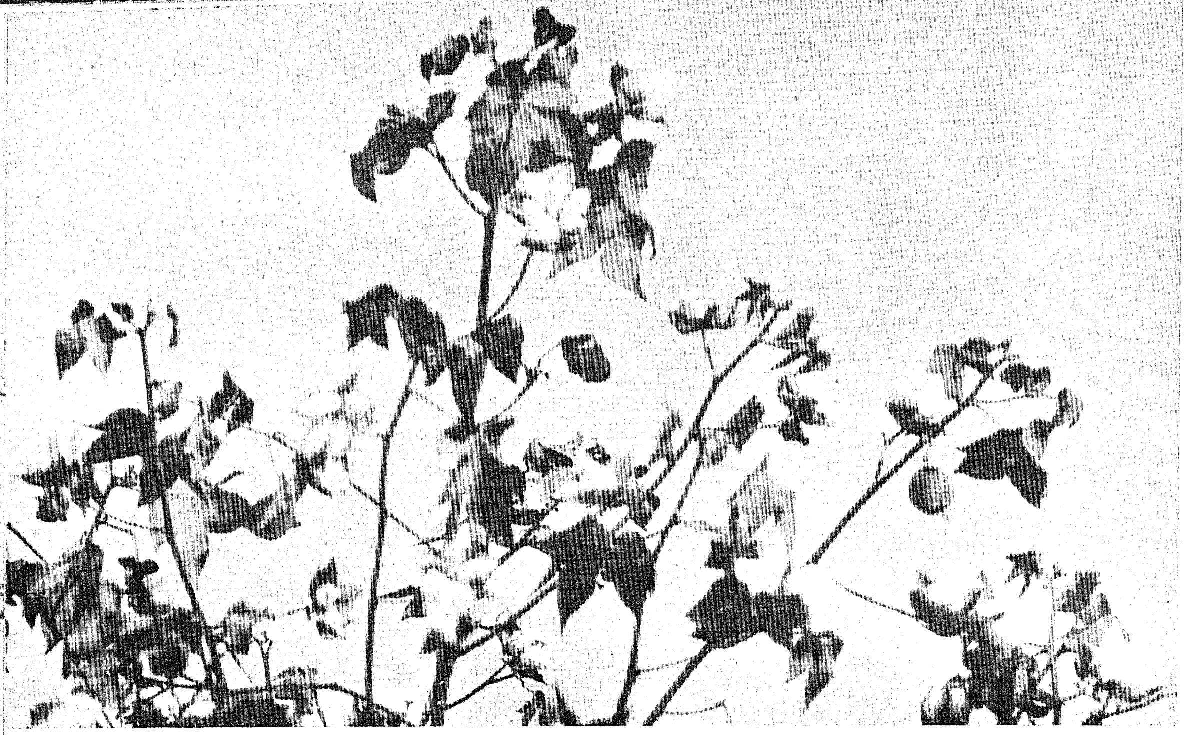
The nature of physiological disorder that develops in cotton plants growing on such lands is different though the end result is the same, viz. premature shedding of the leaves and small bolls with immature seeds and poor quality of lint. On this type of the soil the plants make normal growth up to September. By this time the plant has produced the maximum number of leaves. At this stage the plant begins to show signs of water starvation. The moisture from the first two feet of the soil dries up a week after the usual irrigation is given and the water lost by transpiration (evaporation) from the leaves is not replaced by absorption from the soil. The presence of salinity in the subsoil (from the third foot) interferes with absorption of water by the roots from those deeper layers of the soil. The sodium salts prove toxic and cause the death of young rootlets which are the real water-absorbing organs of the plant. Though the moisture is present in the subsoil it is not available to the plant on account of saline subsoil. The leaves, therefore, lose their turgidity for lack of moisture, begin to assume drooping positions and remain in that position for all the hours of the day and night. This does not happen on normal (non-saline) lands. The drooping leaves are gradually shed.

Once the balance between the demand and



An American cotton plant showing symptoms of *tirak*. The plant had shed its leaves in September and all its bolls had cracked with immature seeds.

PLATE 51



near view of the same plant. Note the cracked bolls. The lint has not fluffed out of the capsule

ATE 52

normal American cotton plant with unshed leaves and fully opened bolls containing mature seeds with good quality of lint

supply of water gets upset other physiological activities of the plant are adversely affected. The leaves become functionless and lose their capacity for manufacturing plant food. This would in turn affect the growth of the plant and especially its fruiting parts. The bolls remain small with immature seeds inside for lack of important nutrients. The leaves are the most important organs of a plant's body and once they become functionless and prematurely senile either due to nitrogen starvation or from water deficiency, the fruits will remain immature.

The time and extent of the water deficiency that will arise in a cotton crop in a field with salinity in the soil depend on a number of factors. They are the size of the plant's body, physical texture of the soil, the degree of salinity, the nature of sodium salts present and their relative amounts. The development of *tirak* and its intensity will therefore depend on the combined effect of all these factors of which salinity is the chief determining factor.

Importance of water supply

The degree of salinity varies and therefore the extent of water deficiency produced in the plant would also vary. There are soils which have low salinity and the plants do not suffer from *tirak* under normal conditions of irrigation and under favourable conditions of weather. If by chance an irrigation is delayed or is missed at the fruiting stage the cotton crop in such fields will develop *tirak*. If the weather conditions during the months of September and October are warm and dry continuously for a number of days they promote a greater water loss than is usually the case and the equilibrium between demand and supply of water is disturbed. It is noticed that *tirak* develops in such lands under such unfavourable weather conditions, while it is not seen on the same land under normal conditions of irrigation and under favourable weather conditions.

Weather conditions are responsible for a greater intensity of *tirak* and its wider spread than normal, on this type of soil, in certain years which are called years of cotton failure. A continuous spell of dry and warm weather in September and October lasting for three to four weeks or more will upset, to a greater extent than normal, the water relations of plants with the soils with saline subsoils and *tirak* will be intensified in such seasons. Such weather will also cause the spread of *tirak* on soils with low salinity in the subsoil. Thus larger areas than the normal will show *tirak*-affected crop in such years of unfavourable weather conditions.

ASSEMBLING AND DISTRIBUTION OF CATTLE IN LAHORE

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PRODUCERS of cattle in the Punjab can be divided into two categories: (1) Producers whose main occupation is cultivation but who also rear stock. (2) Producers who by virtue of their location in some special cattle-breeding areas are interested in the production of stock. In this category may be included the breeders of the Hariana, Montgomery and Dhanni cattle.

The former class are not interested in assembling and distribution, but the latter class of producers sometimes assemble their stock in the cattle fairs held in the districts round about Lahore and are thus interested in distribution as well.

Chain of intermediaries

In accordance with the modern system of marketing in which the producers seldom come in personal contact with consumers, a long chain of intermediaries is found also in the cattle trade. It is specially noticeable in the case of slaughter stock, probably because there are no specialized breeders of slaughter stock in this province and the slaughter stock as a rule consists of old, infirm, and valueless animals. Such animals are usually bought from the producers by the assemblers of stock or dealers in cattle locally known as *beoparis*. In regard to the draught and milch stock trade a separate class of *beoparis* usually takes up the work of assembling and distribution, although sometimes producers are found to assemble their stock in some big cattle fair like that at Amritsar.

Since such intermediaries are different in the case of the three types of stock, i.e. milch, draught and slaughter, they are dealt with separately below.

Milch stock

The *beoparis* engaged in the milch stock trade at Lahore are Aroras, Janglis, Khojas, and people of other miscellaneous castes and professions.

Most of the *beoparis* do not breed their stock but only undertake to assemble it from certain breeding areas. For this purpose they commonly visit the cattle fairs and call on the producers of milch animals. Having purchased their stock, they walk it to Lahore or transport it by rail. On reaching Lahore they offer their cattle for sale at any of the milch-stockyards locally known as *addas* or *ahatas*. Here they have to wait till the cattle are sold. During this period they have to make their own arrangements for feeding their animals and themselves. The *addawallah* (stockyard keeper) makes arrangements for their stay in his *adda*. He offers shelter to the *beoparis* and their animals. Every *addawallah* provides a *beopari* with a *charpoy*, utensils for cooking and a *hukka* (not for each but for all). In fact he tries to please them in every way so that he may attract more *beoparis*. If a *beopari* thinks that it is taking him too long a time to sell his stock in one *adda* and that he can easily sell it in another, he is at perfect liberty to take his animal to the other *adda*; but this is uncommon. In such a case the *beopari* has nothing to pay to the *addawallah*. However, when an animal is sold, the *beopari* has to pay him one rupee for all the facilities enjoyed during his stay. This payment does not vary from one *adda* to another, but is always the same unless some settlement to the contrary is previously made. As long as the animals do not sell, the *beopari* is expected to

sell his milk to the *addawallah* at lower than the market rates. Besides the cost of his living, the cost of feeding the animals till they are sold and the commission which he pays to the *addawallah*, a *beopari* has no other expense in the stockyard. In buying as well as selling, the *beoparis* usually carry on their transactions on a cash basis.

In spite of their comfortable margins of profit, the *beoparis* put up a shabby appearance. This is done probably with a view to evading taxation.

Addawallahs

In Lahore there are about a score of stockyards; six are in Mozang, three in Gowalmandi, two in Safdar Mali; two outside Delhi Gate, one each in Ramnagar and Krishannagar and four near the Badshahi mosque. Every *adda* is a small *mandi* or market in itself. These *addas* are owned mostly by those who have some experience of the cattle trade and are generally well known among the *beoparis* in surrounding areas.

An *adda* consists of an open courtyard measuring about 2 or 2½ *kanals*,* having usually on two and sometimes three sides of it a few sheds built of mud and clay. A few rooms are also provided for housing the *beoparis*. Generally, some arrangement for water is made either by putting in a hand pump or providing a municipal water tap.

The stockyard keeper performs an important service in bringing the sellers in contact with the buyers. He also keeps the *beoparis* in touch with the local demand and bears witness to the sales of animals in his *adda* or *ahata*. An outstanding advantage of such *addas* is that the buyers are given full opportunity to satisfy themselves in every way before purchasing an animal. In this the *addas* have a distinct advantage over the cattle fairs, where the buyers are given very little, if at all any, opportunity to judge the quality of the animal in regard to its milking capabilities. After the price of an animal is settled between the buyer and the seller, the buyer generally pays a rupee to the seller as earnest money. The rest of the money is paid soon after the animal is handed over to the buyer. The buyer has also to pay Re. 1 to the *addawallah* when he has acted as a broker.

The income of the *addawallah* consists of the profits made on milk purchased from the *beoparis* at rates lower than market rates, the commission or stabling fee charged by him on the sale of animals, and the income from the sale of dungcakes. Most of the *addawallahs*, being illiterate, do not keep accounts.

Brokers

The *addawallah* is not a broker in the real sense of the word. Although in Lahore professional brokers of the type found in the cattle fairs are not met with, the *gujars* (the Mohammedan milch-cattle keeping caste) and *gowallas* (the Hindu milch-cattle keeping caste) who generally milk the stock of private owners take up this function, when required by the latter. In addition to bringing information about the availability of stock in some cattle-yards, these *gujars* help buyers in appraising cattle. Such *gujars*, if successful in arranging a bargain, get a commission ranging from 8 as. to Re. 1 from the buyer and the seller. The purchasers of milch cattle for commercial purposes, e.g. *gujars*, *gowallas*, etc. are themselves expert dairymen and can appraise the animal themselves without anybody's guidance.

Draught stock

The trade in draught stock differs in one important respect from the trade in milch stock or slaughter stock. In this case those engaged in assembling the stock are themselves the distributors and they perform this function without the help of brokers or stockyard keepers or the *arhtias* (commission agents). So the only class of people engaged in this trade are *beoparis* and cartmen, the former being the sellers and the latter the buyers.

The *beoparis* of draught stock are the Aroras of Sargodha and Mianwali district and are Hindu or Sikh by religion. They have a virtual monopoly of this trade so far as Lahore is concerned, so much so that the name Arora suggests a draught stock dealer to the cartmen. Formerly, the Pathans and a few zemindars of Lahore were also in this business, but they have now given it up. The Aroras operating in Lahore are not more than 30 in number

* A *kanal* is a measure of area, equal to 0·103 acres.

and belong to only three or four inter-related families.

Having provided themselves with enough cash, they travel in groups and visit the breeding tracts, e.g. Jacobabad, Sibi, Dajjal, Dhanni, etc. and buy the requisite stock with the help of brokers from villages well known for cattle-breeding. They also visit the important cattle fairs in the tracts for adding to their purchases, if the required stock cannot be had from the villages. After completing their purchases they transport their stock by rail or road as convenient. On arrival at Lahore, they hold a small market on any available plot of land. Sometimes they hold markets on *nazul* land (land which has become the property of Government by escheat or failure of heirs) and no rent is paid in such cases. A notice of their arrival is sent by the Aroras to the cartmen who are given liberty to examine the bullocks and to have consultations with their friends. However, they are not allowed to yoke the bullocks to their carts. The bargain is settled without the help of brokers, but after much noisy haggling. The Aroras seldom sell their bullocks for cash and recover the price in two to four instalments. However, they demand at least Rs. 10 before the bullock is taken away. The purchaser has to execute at his own cost a bond on Government-stamped paper binding himself to pay the instalments as they fall due. No interest is charged, but the prices are inflated to cover more than the interest.

Slaughter stock

The slaughter-stock *beoparis* operating in Lahore are commonly the menials or *kamins* of villages in the district and some Pathans from Campbellpur district. They are all Muslims or Christians by religion, and their subcastes are many. The Hindus do not take any part in this trade on religious grounds.

The main function of these *beoparis* is to buy the cattle from the villages and sell them in towns like Lahore, Amritsar, Wazirabad, Sialkot, etc. Having equipped themselves with sufficient cash, the *beoparis* visit the different cattle fairs held in Lahore and nearby districts and Indian states and purchase, according to their needs, the valueless stock available. They also go from village to village purchasing worn-out stock. These *beoparis*, on reaching Lahore, either sell the cattle themselves to the butchers or through the *arhtias* of slaughter stock.

There are no *addas* for the disposal of slaughter stock as in the case of milch animals. However, there is a market on Lytton Road where all the *arhtias* of slaughter stock are localized. Those *beoparis* who want to sell their cattle direct to the butchers exhibit their stock for sale either on the main road or on open ground near the market. Such *beoparis* do not have to pay any market charges on their sales. Others take the stock to *arhtias* to sell the stock. The *arhtias* are directed by the *beoparis* about the minimum price that may be accepted for their stock.

Arhtias

In Lahore there are only three *arhtias* of slaughter stock and as already stated they are all localized on Lytton Road. These *arhtias* belong to Agra. Though only a handful, they play a very important part in this trade. They bring the assemblers of stock (i.e. *beoparis*) in contact with the purchasers (i.e. butchers). They are also the financiers of this trade. They arrange the sale of cattle and pay out of their own funds to the *beoparis*. For this service they charge a commission of 8 as. to Re. 1 per animal on the basis of its price. Besides this, the *arhtia* provides shelter for the *beoparis* and their cattle as long as the cattle are not sold. Every *arhtia* has some special provision for stabling the cattle during the night, while during the day they are often tied outside their shops. The cost of feeding the cattle is, however, to be borne by the *beopari* himself. Again, the *arhtia* sometimes buys the cattle from the *beoparis*, gets them slaughtered and sells the carcases wholesale to the butchers. Furthermore, the hides are also sold through the *arhtias*. They have an elaborate system of keeping accounts.

Butchers

The butchers visit the market on Lytton Road regularly and personally examine all the stock they intend to purchase, and settle prices with the *arhtias*, in case the cattle are being sold through them, or otherwise with the

beoparis themselves. Generally the price is not paid on the spot. When the butchers pay cash there is no *arhat* or commission to the *arhtia* to pay, but in credit transactions commission is to be paid at rates already stated above.

Before the cattle are slaughtered they are examined by a veterinary doctor employed by the Lahore Municipality. Before his arrival in the market, i.e. Lytton Road, all the stock which is intended to be slaughtered is assembled under a tree on the road. This doctor is expected to examine every animal and to pass or reject it as its condition may warrant. The doctor is also entrusted with the task of collecting the terminal tax of Re. 1-2 charged on the entry of each slaughter animal. Besides the payment of the terminal tax of Re. 1-2 per animal, the butcher has to pay 4 as. per animal to the butchers' mosque. On the doctor's direction his assistant brands all the cattle assembled there. The cattle are branded on the neck by means of a branding iron, having a P or R or 2 mark. The cows and calves are branded with P (Pass), and the buffaloes and bulls with the figure 2 (Pass for buffaloes and bulls only) and rejected animals with the letter R.

Suggestions for improvement

The *addas* of Lahore serve a useful purpose inasmuch as they afford convenient places for the buyers to select stock and to convince themselves of the milk-yielding capabilities of the animals they purchase. At present these *addas* are being run in a very mediocre manner. They require recognition from some authority, whether the Municipal Committee or some other body. Some suggestions for their improvement are :

(1) Wider publicity to the existence and location of these *addas* should be given by the Municipality or other body.

(2) A water tap should be provided by the Municipal Committee in every *adda*. The existing facilities for water are inadequate.

(3) The Municipality should fix one day in a week as the day on which sales of animals should be effected by open auction in these *addas*.

D

BETTER RETURNS FOR FRUIT-GROWERS—II*

By
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Horticulturist, N. W. F. P.

THERE should be no end to a man's ambition. A grower who succeeds in securing profits of over Rs. 90 per acre from a six-year-old orchard should try to secure still better returns. Could the profits from the orchard discussed in Part I of this article, published in the last issue, as an example, be improved upon ? That this is possible, by the orchard analysis method, will be shown below.

Tree as unit

The first essential for achieving our object is to bring about a change in the outlook of the fruit-grower. At present he thinks of his orchards in terms of acres. He should think of them in terms of trees. An orchard should be compared to a dairy herd, the trees to individual cows, and just as a modern dairyman keeps daily milk-yields of individual cows, so should a progressive orchardist maintain annual yield records of individual trees. It is only then that he can come into intimate association with his trees, understand their individual requirements, and be in a position to deal in time with pests and diseases, before serious harm is done.

Before individual tree records can be maintained, it is necessary to establish tree identity for each tree. For this purpose, a system of labelling is in vogue at the Tarnab Farm. Each tree bears a metallic label hung by means of a wire from the tree in a conspicuous position, about two feet above the ground-level. Each tree bears two numbers on the label. The upper one indicates the line number and the lower one the tree number. Such labelling costs, on the average, 1 anna per tree. After labelling, the next step is to keep individual tree yield records. These will serve a twofold purpose :

(*a*) help to show high-yielding trees, from which bud wood should be taken for propagation, and

(*b*) mark out low-bearing trees, so that steps may be taken to improve their yield.

Production chart

A plan of the orchard should be prepared, so that each tree is represented on it by a square. Tree yields should then be entered in these squares. Such a chart is called a production chart. Such a chart, for the peach orchard 3, which is under discussion, is given on page 189.

Each square represents a tree, and the number in it the yield it gave in lb. of fruit in 1939. The chart shows at a glance the big variation in yield from tree to tree. It also shows clearly a very large number of low-yielding trees. It is now evident that if the low-yielding trees could be brought to the level of the high-yielding ones, considerable improvement in returns would be effected. Before we proceed to that, let us find out individually the profitable and non-profitable trees in the orchard.

Distribution chart

The yield of each tree is given above. From the sale prices of fruits the income realized per acre can be worked out. The cost of production per acre is already given, from which the cost per tree is worked out. The income and the cost for each tree will show whether the tree is profitable or not. When this is worked out for each tree and shown in the form of a chart, it is called the distribution chart for that orchard. Such a chart prepared for the orchard under discussion is given on page 190.

* Part I appeared in the March issue.

Production chart for 1939

			12	13			7	5			13	3	3	2	3
	3	7	10	20	5	5	4	9	6	10		20	8	6	4
	6	18	10	18	16	6	2	16	10	9	8	5	5	3	9
10	5	3	6	7	12	18	12	21	9	16	3	8	3	13	16
9	1	9	16		11	5	11	18	14	16	21	28	11	6	
14		10	9	7	14	1	14	17	17	14	12	19	13	10	
10	4	3	8	7	15	8	6	6	6	8	10	17	6	10	18
7		16	8	15	9	15	6	7	9	6	12	7	17	14	9
6	6	3	8	12	10	6	6	11	5	3	12	1	10	6	8
6	5	5	7	10	17	4	5	9	13	1	2		11	6	14
6	12	3	14	5	9	11	17	6	4	4	11	3	9	8	16
19	21	7	7	20	20	32	15	11	4	4	12	8	5	11	14
7	9	5	2	9	5	3	12	2	2	2	6	8	3	9	13
14	5	6	2	6	7	10	3	6	14	2	8	14	13	10	14
8	4	1	4	3	8	5	12	4	7	6	2	10	7	21	13
7	3		4	12	3	2	8	8	12	8	5	23	15	10	15
3	6	4	4	22	42	16	5	9	15	3	9	12	16	13	2
3	11	6	3	6	7	5	2	6	3	9	8	14	4	3	19
	5	2	9	6	13	6	5	7	4	6	9	10	3	2	17
2	1	2	4	12	14	19	16	16	15	7	5	15	12	26	15
1		3	7	7	5	8	4	8	8	9	11	19	14	16	21
2		3		6	3	3	4	7	42	16	13	23	27	24	31
1		1	1	1	2	2	6		7	5	12	10	8	27	14
1	9		1	1	4	2	1	3	13	6	13	4	19	9	10
1	2				1	4	5	5	5	4	4	12	8	6	27
	3		1		1	4	3	4	2	2	2	6	4	8	7
	1	1		1		2	6	1	1		3	3	4	3	9
			3	1		4	9	2	8	8	2		1	2	10

All the trees are divided into three categories, the profitable, the self-supporters, and the unprofitable ones. In the chart on page 190 the dark squares represent the profitable trees, the lined squares the self-supporters, and the blank squares the unprofitable ones. According to the above chart, there are 448 trees in the orchard; of these 123 or 27·45 per cent are profitable; 99 or 22·10 per cent self-supporters and the remaining 266 or 50·45 per cent unprofitable. The production chart also shows the efficiency of the orchard, which in this particular case is only 27·45 per cent. The chart brings out two important points :

(i) That in the orchard only 27·45 per cent of the trees or hardly one in every three trees, returns a profit, while the remaining 72·55 per cent or two out of every three trees, do not give any profit at all.

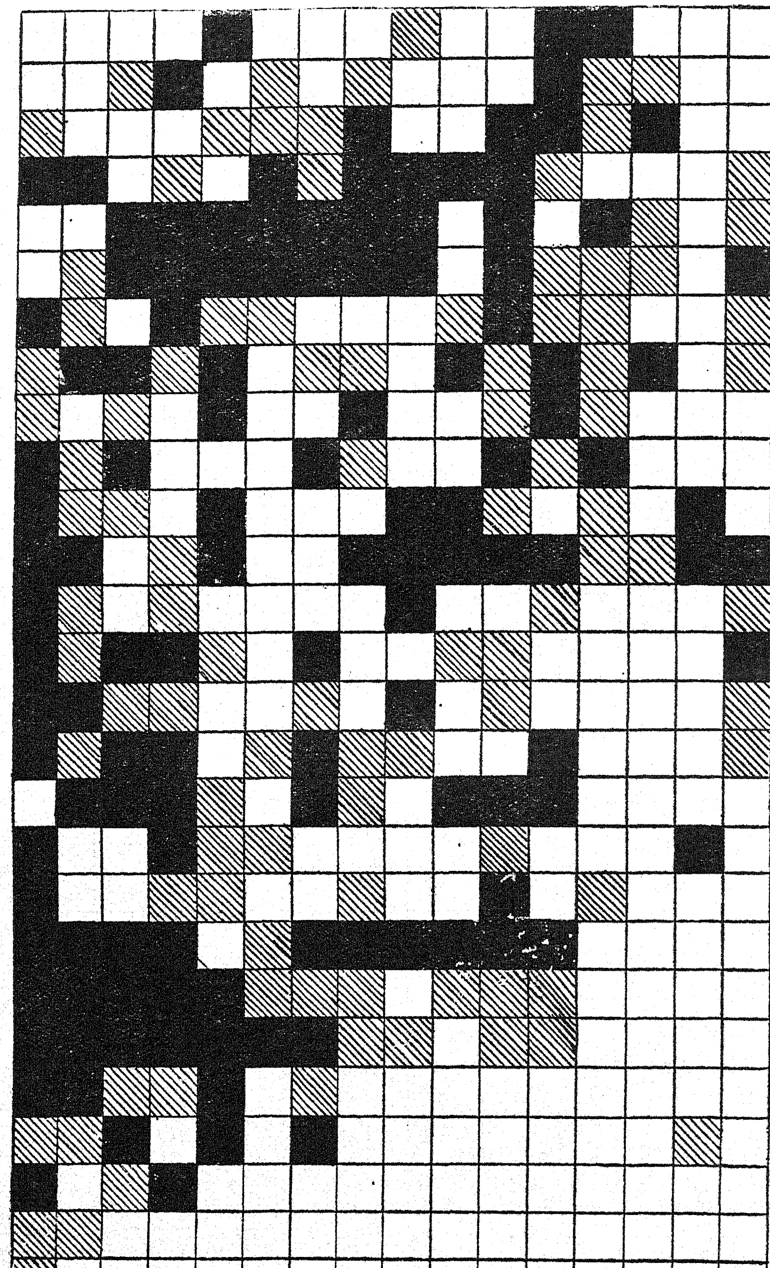
(ii) It is also clear that a profit of Rs. 92-7 per acre was made with only 27·45 per cent trees returning a profit. Therefore, if the remaining 72·55 per cent were also to return a profit individually, the net profit per acre would be increased to more than three times the above figure.

The problem now before us is to bring the yield of the unprofitable trees to the level of the profitable ones. Orchard analysis should help us in determining how best this can be achieved.

Orchard analysis

In the orchard there were 325 trees or 72·55

Distribution chart for 1939



per cent of the total number of trees, which did not give a profit. To find out the reasons for the low yield in these trees, each one of them was carefully gone over. It was found that in 44 trees or 9·82 per cent of the orchard, the low yield was due to these trees being of a younger age, because they were refills. This shows the great importance of taking good care of new plantations till the trees are well established, because the mortality in trees occurring at this stage has its effect on orchard returns in future years. The loss from these can be avoided by great care of young plants till they are well established. This still leaves another 62·83 per cent low-bearing trees in the orchard. The low yield in these may be due to

(*a*) Environmental causes, and

(*b*) Inherent characters.

Environmental causes

(i) *Irrigation.* Examination of the distribution chart shows two big bands of unprofitable trees, to the north and south of the orchard. The northern band extends over three rows and the southern over six rows. These low-yielding trees constitute definite groups, showing that there is a common factor influencing their production. Such a factor is clearly outside the trees and must be environmental in nature. Generally, the low-yielding bands along the borders of the orchard are due to some defect in the irrigation system. In the present case, the main water channel runs east to west, along the southern side of the orchard. A number of secondary water channels arise from the main water channel and run northwards. These carry water to the individual plots. The soil of the orchard is of a heavy type. The low yield from the six rows to the south of the orchard is due to excessive moisture. These are near the main water supply channel and therefore get far more water than any other area of the orchard. This causes waterlogging and lack of aeration. The low yield from the three rows to the north of the orchard is on the other hand due to the lack of water supply. These are at the farthest end from the source of water supply and therefore get the least amount of water.

In these two bands there are 94 low-yielding trees, or 20·98 per cent of the orchard, giving poor yield because of the defective system of irrigation. The remedy would lie in altering the irrigation system. For instance, the main water channel should run through the centre of the field and the secondary water channels north and south from it, to carry water to individual plots.

(ii) *Soil variation.* A look at one of the two charts shows that a large number of the high-yielding trees lie to the west of the orchard and similarly a large number of low-yielding trees lie on the eastern side. This shows that the soil fertility diminishes as we move in the orchard from west to east. In the last four rows to the east, there are 56 low-yielding trees or 12·50 per cent of the total number of trees. These lie in two adjacent bands. The low yield in these is due to low soil fertility and can be remedied by extra manuring.

There are 92 low-yielding trees or 20·43 per cent of the total number which are distributed in many small groups in the central parts of the orchard. The low yield in these can be attributed to soil variation combined with the incidence of pests and can be overcome by manuring and spraying.

(iii) *Diseases.* There are some 30 low-yielding trees, or 6·69 per cent of the total number of trees, in which the low yield is due to severe attack of peach shoot borers. As no other cause of the low-yield in these trees could be detected, it could be attributed to pest attack only. The remedy in this case would be spraying and other control measures for the shoot borers. This does not mean that there are only 30 trees in the orchard with the shoot borer attack. This pest is found in a large number of other trees also, but there the cause of the low yield in trees is some other factor and the insects appear at a later stage.

Inherent factors

When the low-yielding trees occur according to the law of chance, the cause of the low yield invariably lies within the trees themselves. The poor performance in trees may then be attributed to

(*a*) The root stock,

(*b*) Inherent poor-bearing capacity of the trees.

In the former case, the state of bud union of the tree may be looked into. If it is swollen and abnormal, it is a clear indication of unsatisfactory stock. In the orchard under discussion, no trees with unsuitable stocks could be traced.

When the stock is satisfactory and the low yield in a tree cannot be attributed to any of the environmental factors, it may be concluded that it represents an inherently low producing strain. In this orchard, there were only ten trees, or 2·23 per cent of the total number of trees, in which low yield could be attributed to inherent causes. Such trees may be top worked by taking buds from consistently high-yielding trees. If this fails, the trees should be removed and replaced by new ones.

In a six-year-old orchard of 6A variety peach trees, a net profit of Rs. 92-7 per acre was realized by following an efficient system of management as explained in Part I of this article published in the last issue. The distribution chart of the same orchard revealed that its efficiency was only 27·45 per cent and that 72·55 per cent of the trees were not bringing in any profit. By orchard analysis the reasons for the low yield in 72·55 per cent of the trees were determined and methods shown to bring their yield to the level of the profitable trees, or in other words, ways have been suggested for raising orchard efficiency from 27·45 to 100 per cent.

It should therefore be clear that when with 27·45 per cent orchard efficiency a profit of Rs. 92-7 was realized, with an increase in the efficiency of the same orchard to 100 per cent by the methods explained in this article, there is a possibility of increasing profits to more than three times the above figure.

The authors' thanks are due to Dr W. Burns, D.Sc., C.I.E., I.A.S., Agricultural Commissioner with the Government of India, for very carefully going through the paper and for corrections and suggestions which have considerably improved this article.

SELF-STERILITY AND PLANT BREEDING

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It is not uncommon for plant breeders to underrate the value of genetics in its application to plant improvement. Plant breeding, according to them, is still an art in spite of 40 years of genetic research; its methods are empirical and depend for success more on chance than any scientific principles. This feeling is perhaps a natural reaction to the optimism that followed the rediscovery of Mendel's laws in 1900, when exaggerated claims were made for them. It was then thought that genetics would eventually succeed in analysing crop plants into their hereditary units—the genes—and as a consequence the production of any desired type of plant would become an easy matter of permutation and combination of these genes by suitable hybridization.

Genetic discoveries

With the progress of genetic research, however, it became evident that some of the more important economic characters like yield and quality were not easily analysable as they were found to depend on a large number of factors each with its own individual effect and subject to considerable modification by environment. So the early dream of the plant breeder remained far from fulfilment. Nevertheless, there are other directions in which genetic research has contributed substantially to practical breeding. The theories of the pure line, heterosis (hybrid vigour) and the chromosome basis of heredity are a few of the fundamental genetic discoveries on which are based some of the outstanding achievements of crop improvement. The practical implications of genetic research in self-sterile plants (those that will not set seed with their own pollen) are becoming increasingly evident for formulating successful techniques for breeding in these crops. If we are therefore to make further progress in plant breeding, we ought to concentrate on the study of the hereditary make-up of our crop plants more in regard to their physiological characters than the relatively unimportant morphological characters to which the geneticists have been devoting their attention so far.

An attempt is made in this short article to explain the value of genetic studies in relation to the improvement of self-sterile crops.

What is self-sterility?

Sterility in plants, as commonly understood, includes any situation in which the optimum fruiting is not obtained. This may be due to the suppression of either one or both organs of sex in the plant or the production of abortive sexual elements, viz. pollen and ovules or to what is known as 'incompatibility', which is also known as 'self-sterility'. Incompatibility may be explained as the failure of pollen, although functional, to grow down the style and effect fertilization. This incompatibility between pollen and style may be self or cross; in the first case the pollen is not able to fertilize the ovules of the same plant and in the second case the pollen is not able to fertilize the ovules of another plant of the same variety or species. In these cases, the pollen and ovules are quite functional and the failure of fertilization is due to certain genetic factors for incompatibility.

Widespread among plants

Self-sterility is widespread among the various families of the angiosperms. East, who has recently reviewed the situation, says that 'a rough calculation of the number of described species of angiosperms that are self-sterile based on the assumption that plants studied carefully are a random sample, gives a figure of 3,000'. He also says that this phenomenon is more frequent in herbaceous plants than in woody ones. Plants of agricultural value being usually herbaceous, the importance of this problem to practical breeding is at once apparent.

Hereditary character

The phenomenon of self-sterility was known to the early hybridizers; as early as 1764 Kolreuter discovered that plants of *Verbascum phoeniceum* failed to set seed with their apparently good pollen although they would readily set seed with pollen from other species. Since that time, numerous cases of self-sterility in plants have been discovered and many sustained investigations on the genetics of this phenomenon carried out. In 1925, East and Mangelsdorf, as a result of a rigid analysis of their work on Nicotiana species, proposed a satisfactory genetic interpretation of their results, which apparently seemed valid for all the tests. They said that both self- and cross-incompatibilities which prevent the self-fertilization of certain individuals and cross-fertilization of these individuals with others was a genetic phenomenon being determined by genes just as other morphological characters. There are a number of self-sterility factors present in a population of any one species which may be designated as S^1, S^2, S^3,. . . .S^n, but only two of these are present in any one individual. This condition in which more than two genes are involved in an alternative system but only two of which can be present in a given individual is called a multiple allelomorph. Thus in Nicotiana, 15 self-sterility genes and in clover 13 have already been identified. The mode of action of these genes is peculiar. Pollen carrying a particular gene—say S^1—will not grow down the style carrying the same factor, although it will do so readily in the style of another plant carrying a different factor. Thus a plant of the constitution S^1 S^2 will not only be self-sterile but also cross-sterile with plants of the same constitution. S^1 S^2 plants will, however, cross readily with S^3 S^4, S^3 S^5, etc. which carry different factors from their own. Thus it follows that in any population the greater the number of these genes the lesser are the chances of incompatibility between plants. The tests for the presence of these self-sterility factors are made by making all possible matings in a group of plants and this brings out the existence of intra-sterile and inter-fertile groups of plants indicating that the plants in each intra-sterile group are of the same genetic constitution.

This explanation of the situation which postulates 'like repelling like' is termed the oppositional factor hypothesis. In most of the plants so far investigated, the behaviour of incompatibilities has been found to conform to this hypothesis. A few cases have been met with, however, in which the inheritance was complicated. Self-fertility factors designated S^1 which are either allelomorphic to S factors or are independent of them have been identified which modify the action of S genes and give rise to complications in inheritance. Kakizaki working on *Brassica oleracea* in Japan has postulated the presence of two independent series of genes determining the inheritance of incompatibilities. The one series consisting of S genes inhibited the growth of pollen tubes and another series of T genes stimulated it when the same gene was present in the pollen and style. The S series was, however, more active than the T series but T in double dose was more active than the S in single dose. Another source of complication in the oppositional factor hypothesis is that induced by polyploidy (presence of more than two basic sets of chromosomes). In a diploid with two basic sets of chromosomes, each gamete (sexual cell) will contain only one incompatibility factor and there will be produced only two types of gametes. In polyploids—say for instance a hexaploid with six basic sets of chromosomes —each gamete will contain three incompatibility factors and the number of gametic types will be greatly increased. Therefore in polyploid plants there is bound to be greater variability in the behaviour of incompatibility and the chances of individuals of similar constitution meeting to form incompatible groups are correspondingly lessened. This expectation has been confirmed in the case of fruit trees where incompatibility is not so common in the hexaploid plums as in diploid cherries and it is even less frequent in even more complex polyploid apples.

Practical implications

The occurrence of incompatibility in plants is a great handicap to the breeder. In the first place it deprives him of the use of self-fertilization which is 'an important tool in his kit' and in the second place any improved variety that he may produce is subject to

Apetalous mutant Normal

‘ Closed petal ’ mutant   Normal

PLATE 54

rapid deterioration by extensive cross-pollination which is the rule in all self-sterile species. So the comparatively easy work of isolating superior strains and maintaining their purity thereafter, which is successfully followed in self-fertile crops like wheat and rice, is not directly applicable to self-sterile crops. Hence the production of self-fertile races and the formulation of new methods of breeding based on the genetics of self-sterility are essential prerequisites for dealing with these crops. The isolation of a self-fertile mutant in self-sterile clover and the new techniques of breeding formulated by Williams of Aberytswyth are achievements in this direction. Again, in the field of horticulture, the occurrence of incompatibility raises problems to the fruit grower. Apparently healthy trees, in some cases, fail to yield satisfactory crops. Examination of their fertility relationships will show that they are all genetically alike, having been derived by vegetative propagation. In such cases interplanting of compatible varieties or top-grafting of compatible scions will remedy the defect. Polyploidy in certain cases is also known to reduce incompatibility.

Preliminary work on Brassicae

Of the two important species of *Brassica*, viz. *B. campestris* and *B. juncea* grown for oil in North India, the former includes varieties locally termed *toria*, *lahi*, etc. which are practically self-sterile. This crop is grown extensively in the canal colonies of the Punjab and in the eastern districts of the United Provinces and has the highest oil percentage varying from 44 to 49 per cent. Breeding superior varieties in this crop has been mainly restricted to mass selections because of inherent difficulties arising from self-sterility in the species. Work on this crop was started at the Imperial Agricultural Research Institute in 1939 to find out better methods of breeding. This naturally involved the investigation of (1) the possibility of producing self-fertile races, (2) ensuring their self-pollination, and (3) of detecting any 'rogues' that may occur in their progenies as a result of cross-pollination with other varieties. As the studies are still in progress only a brief reference to the various lines of work is made here,

The distribution of self-sterility in the several varieties of *toria* has been studied for the last two years and it has been found that the crop is practically self-sterile ; no self-fertile plant has so far been detected except the one mentioned below. The inheritance of self-sterility has also been under study and the results so far obtained point to a complicated type involving genes situated on more than one pair of chromosomes. One interesting plant has, however, been obtained in one family which is not only self-fertile but also cross-fertile with several other sister plants. It is presumed that this plant is a mutation and its further breeding behaviour is under investigation.

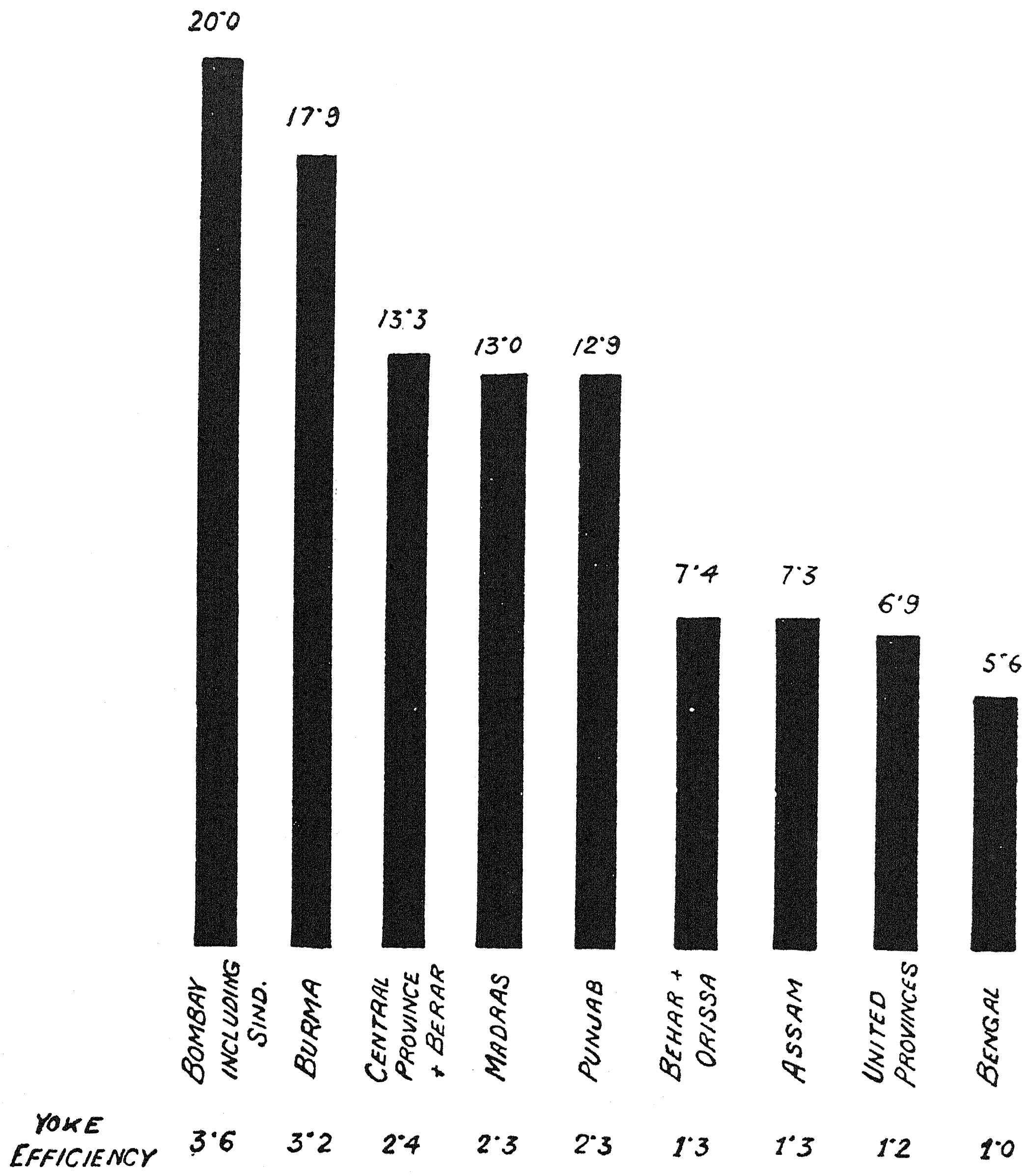
As regards items (2) and (3) the study of the pollinating mechanism and the extent of natural cross-pollination in several varieties is being made. In the course of this study two interesting mutations, not known before, were discovered which promise to be of great use in practical breeding work. One was an erect compact plant with flowers devoid of the bright yellow petals and this peculiarity gave it a strikingly different appearance from the normal plants. A number of unopened buds from this plant were dissected and examined and in every case it was found that the stamens were inserted immediately after the sepals, the whorl of petals being absent (Plate 53). Seed setting was excellent in this plant both under conditions of open and self-pollination. Crosses between this apetalous plant and normal plants were made and studied up to the F_2 generation. The results have shown that the apetalous condition is a simple recessive to the petalous condition. As regards the extent of natural cross-pollination occurring in these plants, it has been found by growing several of these open-pollinated plants collected from different parts of the field that only about 6 per cent out-crossing takes place ; and the hybrid plants arising from cross-pollination with other varieties are easily detected as all of them have petals, the petalous condition being dominant. Here then is a useful gene which can be bred into a superior strain with advantage as it would considerably reduce the extent of natural cross-pollination and at the same time afford easy means of

detecting the few 'rogues' that may creep in through cross-pollination.

Another very useful mutant that was discovered is a 'closed petal' mutant (Plate 54). In this plant the petals which enclose the stamens and stigma in the bud stage continue to do so until they wither and fall off by which time the stigma becomes non-receptive to foreign pollen. Here again is an effective mechanism for self-pollination in nature and this has also been found to be a simple recessive to the normal condition. Unfortunately, in this case the plant is self-sterile and no setting takes place in the field as foreign pollen which can induce setting of seeds is excluded. Nevertheless, it is a useful gene which can be put on to any self-fertile strain by suitable breeding methods for keeping down cross-pollination and thus maintaining its purity. It is hoped that work on these lines will lead to useful results which will help in the formulation of successful methods for the improvement of this crop.

AREA CULTIVATED PER YOKE

(Acres)



Based on the Report of Royal Commission on Agriculture in India

RICE STRAW : ITS FEEDING VALUE AND HOW TO IMPROVE IT

By INDUBHUSAN CHATTERJEE, M.SC. (AGR.), L.AG.
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AMONG the food crops of India, rice occupies the largest area (72 million acres), being about 25 per cent of the total area sown. An idea of its extent can be gathered from the fact that it covers over three times that under wheat, five times that under pulses and almost twice the combined area under *jowar*, *bajra* and maize. In the provinces its proportion on the basis of net area sown is 83 per cent in Assam, 93 per cent in Bengal, 46 per cent in Bihar, 79 per cent in Orissa, 32 per cent in Madras, 23 per cent in the Central Provinces and Berar, 19 per cent in the United Provinces, 7 per cent in Bombay, 23 per cent in Sind and 3·5 per cent in the Punjab. It is thus the predominant crop in a large part of India, where it forms the staple food. Correspondingly, the straw released from the crop forms the staple roughage of the bulk of the cattle in those areas.

Small cattle in rice areas

It is a matter of particular significance that all over the rice tracts cattle are smaller in size and larger in number. In such widely scattered areas like the Kangra district in the Punjab, Gorakhpur district in the United Provinces, Raipur district in the Central Provinces, Tanjore district in the Madras Province and in the predominantly rice areas of Assam, Bengal, Bihar and Orissa, the cattle are invariably poor and less efficient; and the number of bullocks per 100 acres of net sown area is something like three to four times that of other areas. The Royal Commission on Agriculture has cited data from which it appears that a pair of bullocks in the Bombay Province is able to manage about 20 acres whereas in a predominantly rice-growing tract like Bengal it can only do about 5·5 acres.

This fact has been very aptly illustrated in the accompanying chart based on the same report. The yoke efficiency of the animals has been calculated from the area cultivated for yoke. This shows in striking contrast the low efficiency of the Bengal animals. The superior efficiency in respect of some of the other provinces provides instances suggesting the extent of improvement that might possibly be effected in the backward areas.

It may be held that the cultivation of rice by its very nature is more time-absorbing and thereby requires more animals, but that is true only to a certain extent as it cannot provide any explanation of the poor and dwarfed condition of the animals. This is bound to be related to the kind and quality of food which gives them nourishment. If we visualize the dim past when the forefathers of the present local stock first came to these parts of the country, the successive stages in the picture would unfold an episode in which decadence followed in the wake of deficiency until by slow degrees of waning vitality, quality receded and quantity soared up; and we have today the unhappy spectacle of a staggering horde of inefficient and undersized animals. There cannot be any doubt that malnutrition has been a determining factor in this process of slow deterioration, and since rice straw has virtually been and will probably remain the staple fodder, its judicious feeding is of as much importance to future well-being as its unbalanced feeding must have largely contributed towards the present situation.

Defect of rice straw

The main defect of rice straw is that it is very poor in protein and phosphorus and contains a large quantity of crude fibre on the one hand and a substance which interferes with the proper absorption of lime on the other. Again, depending on the nature of feed combination and kind of straw, the digestibility of straw protein varies from nil or even negative

* Appointed under a grant from the Imperial Council of Agricultural Research.

(i.e. more is excreted than is supplied through the straw) to 3, 4, 5 going up to 34 per cent. Thus in an experiment with winter or *Amon* variety of straw as an exclusive feed which was continued for a period of 111 to 150 days, the animals (starting live-weight 375 to 403 lb.) lost to the extent of 38 to 85 lb. and the efficiency of general digestion was reduced by 25 per cent in the course of only two months, whereas in subsequent periods it became still worse. As an instance, the animal which was able to derive 5·3 lb. total digestible nutrients during the first test could not draw more than 3·9 lb. during the second test after an interval of two months. This worked out at the rate of 25·23 lb. energy value (starch equivalent) per 100 lb. fresh straw as compared to 12·2 lb. during the second test. In the case of another animal the result was still more disappointing; the first test yielding 21·98 lb. starch equivalent as compared to only 5·96 lb. during the second test. When a balance sheet of the intake and outgo of the essential body components was drawn, more protein, lime, magnesia and phosphorus were drained out of the body than were supplied in the feed, with the inevitable result that the animal lost in condition, body-weight and thriftiness. As soon as the animals were provided with a suitable concentrate (linseed cake), a valuable combination of protein and phosphorus ensued with the result that not only did the general appetite and consumption go up but there was definitely better utilization and assimilation of the food components, and the animals gained in weight.

It should be stated that the feeding trials were carried out with bullocks at rest, as the requirement at rest needs first to be satisfied; and making this the starting point, the other additional requirements such as for milk production, development of foetus, work, etc. have to be provided. It should also be noted that although linseed cake is a high-class concentrate, it is not a common feed in use in any part of India. In Bengal mustard cake is the main concentrate and rice bran is also used. In other rice tracts, for instance Assam, Orissa, and parts of lower and upper Burma, rice bran is the main concentrate. It was therefore necessary to conduct feeding and metabolic experiments in which rice straw was used as roughage and mustard cake or rice bran (locally known as rice *kura*) was used as concentrate.

How tests were made

The method of experiment is as follows:

A number of suitable animals (generally bullocks) are subjected to a preliminary feeding with the respective feed combinations. The feeds and residues are all weighed and dry matter estimation and other chemical analyses of relevant materials made. When the animals settle down to their courses of feeding, rigorous collection for at least ten consecutive nights and days are made of feeds, faeces, urine, water, etc. and they are later on subjected to chemical analysis. A balance sheet is then drawn up of the intake and excretion of the essential constituents. This shows whether any particular components were more or less than the requirement. At the same time the daily body-weights of the animals are recorded and in cases where it is required to follow the continuous effect, the feeding is prolonged for a longer period and at intervals metabolic tests are conducted on the lines described above.

The results indicate the following notable features:

I. *Rice straw:* (*a*) For maintenance the energy requirement is met from the supply of rice straw.

(*b*) Rice straw is deficient in nitrogen and unless this deficiency is made up through other sources, such as concentrates and green feeds, etc. it will adversely react even on the efficient utilization of energy and other components present in it.

(*c*) Rice straw is poor in phosphorus and even this supply is of doubtful efficiency.

(*d*) Rice straw contains a large quantity of potash. It is just possible that large amounts of potash may partially retard lime assimilation.

(*e*) Although rice straw generally contains a fair supply of lime, there is present in it a large quantity of oxalic acid which has the property of rendering lime insoluble. It has been found by other workers like Sherman, Fincke and Maynard that oxalic acid in feeds retards lime assimilation. Very likely the same reason holds here. At any rate it has been found under rice straw feeding that

unless the lime supply (depending on the kind of straw) reaches the level of 40 to 60 grams (equivalent to 3·3 to 5 tolas) per 1,000 lb. body-weight, the physiological equilibrium is disturbed, and in order to meet the requirement the system draws from the body. This is reflected in a minus or adverse gain for the animal.

II. *Rice straw and mustard cake:* When the straw was fed with mustard cake, the condition from external appearance as judged from body-weights, etc. gave an indication for the better. But when the intake of essential nutrients was carefully examined, it was a surprise to find that in spite of a considerably large intake of potash more was voided out than was provided in the feed. This behaviour has been noticed in a very large number of experiments, but the cause of it is yet under investigation.

It may, however, be noted that potash forms a considerable part of the mineral fraction of body tissues. But when more potash is voided out than is supplied in the feed, it may be related with a possible breakdown of body tissues. On the other hand, tissue-breakdown generally occurs when the feed proteins lack the essential amino-acids. In the present case the feeds consisted of rice straw and mustard cake. Very little is known of the nature of amino-acids in mustard protein. If it is deficient, the body, in its attempt to meet the physiological needs of its system, will sacrifice a part of its tissue protein and in such a case the other associative components of the tissues including potash will necessarily come out as the products of disintegration. As, however, the matter has only recently come to notice, it cannot be stated if the cause is related with such a possibility. It is true that a definite remedy is possible only when the cause is fully known. In the meantime some remedy is needed and that can only be suggested having regard to the possible causes.

It has been already stated that if there is a deficiency of essential amino-acids in the feed, tissue-breakdown ensues. This can be arrested by providing an assortment of foods so that the protein of one might supplement the deficiency in the other, and in that way the requirements of body protein will be met. When this requirement is satisfied it will also have a wholesome effect on the restoration of other associative components of which potash is an important one. It will be advisable therefore that when mustard cake is fed it should be supplemented with such other feeds whose protein components are better provided with the essential amino-acids.

Here also we have to suggest only such food as would be economically and conveniently available. Under Bengal conditions the by-products of pulses, rice bran and sometimes *til* or gingelly cake form probably the limited source of concentrates. Nowadays there is some cultivation of groundnut and this may also serve as a useful source. The main fact that should be borne in mind is that an assortment of feeds makes for the best combination; and keeping that in view one should make the best of what is within his reach. To these a supplement of green feed is also a great necessity.

III. *Rice by-product and rice straw:* According to the estimate made by the Marketing Officer, Bengal, in 1934-35, the production of unhusked paddy grain in Bengal was about 11 million tons. A recent enquiry made by the writer suggests that the mill by-products which provide material for cattle feed form about 20 to 22 per cent of paddy output. An appreciable portion of it is very coarse but broadly about 60 per cent is capable of yielding a better class of cattle feed. On this basis the yield of by-product would work out at about 1·3 million tons or 35 million maunds. Bengal has a cattle population of 25 millions and this will allow about 1·4 maunds of rice by-product per head. Considering the limitations of supply, it means a cheap and fairly good cattle feed within the reach of the cultivator. The protein of rice by-product is credited with high biological value; besides, the *kura* is often very rich in oil and phosphorus. On this account feeding and metabolic tests were conducted in the Animal Nutrition Section, Bengal, but the results indicated that when it was given as the only concentrate with rice straw, the general consumption and appetite were lowered although it was able to maintain the protein equilibrium with a comparatively lower protein supply. Its main

defect seems to be associated with low calcium content, on the one hand, and the poor assimilation of the phosphorus complex on the other, although the total phosphorus content present in it has been found to be usually large. The calcium deficiency can be remedied by providing a supplement of lime compound, but in the case of phosphorus it is necessary to treat the material in such a way as to render it assimilable. The Bengal Nutrition Section is engaged in this investigation for which the Imperial Council of Agricultural Research has also provided an extra grant, and some tangible result is expected in due course. Tentatively it is suggested that rice *kura* should better be fed in combination with cake, some green forage and a small quantity of powdered chalk to supplement lime deficiency.

IV. *Rice straw and green fodder:* Feeding and metabolic tests were carried out with rice straw and Napier grass, rice straw and Napier silage, rice straw and guinea grass and rice straw and water hyacinth. The best result was with the combination of guinea grass. Napier grass is well provided with phosphorus, but lime was rather poor. Napier silage was still more deficient in lime, whereas water hyacinth gave the worst result.

Change in feeding required

The object of feeding is to provide body builder (from protein), bone former (from lime and phosphorus) and energy (from carbohydrate and fat). There should also be a fair supply of vitamins to provide the basis for wholesome assimilation and development. In Bengal rice straw is the staple fodder and mustard cake and rice *kura* (by-product of the rice mills) are the main concentrates. Neither of them singly can ensure better assimilation. They have to be given in combination and along with them a small amount of pulses, other by-products and green forage should be given.

It need hardly be stated that straw as a class is inferior in feeding value. But in rice tracts no other fodder is generally available. Naturally the best use has to be made out of it. In Europe and America the use of straw, especially for dairy cows, growing or fattening cattle or for work animals is not very common. But as Morrison says, when there is a shortage of better roughage, 'considerable straw can be fed to these classes of stock with fair results, if care is taken to feed more concentrates than usual, and to add a calcium and phosphorus supplement when necessary'.

In India no work on feeding rice straw has so far been done with dairy cows, but the work of Warth and Gossip with calves at Karnal* suggests that rice straw is eaten more readily and produces better growth than wheat straw. From external nutritive effect as reflected in live-weight, etc., rice straw and sorghum behaved similarly and appreciable changes in the digestion of protein and carbohydrate occurred when the protein was varied, the digestibility increasing with the amount of protein. No mineral metabolism test was undertaken, but concentrates formed a part of feeding. The satisfactory results obtained there suggest that the concentrates fed did not suffer from the defect noticed during the feeding of rice straw with mustard cake in the Bengal experiments.

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RURAL RECONSTRUCTION IN MADRAS

THE pivot of rural reconstruction work in this province is the Collector. Collectors of districts convene periodical conferences of district officers and members of the legislature resident in the district once a quarter to consider proposals for the utilization of the Government of India grant and to discuss matters pertaining to the administration of the district. The planning of rural improvements best suited to the needs of the district is the duty of the conference. The agencies to carry out the improvements are the Revenue, Irrigation, Cooperative, Forest, Agricultural and Veterinary Departments, whose activities are controlled and coordinated by the Collector.

The Government of India grant is utilized on the following objects:

(1) Improvement of rural water supply including bore-wells;

(2) Improvement of rural sanitation;

(3) Improvement of village communications including the bridging of irrigation canals and channels at places where they are needed;

(4) Encouragement and development of co-operative loan and sale societies by giving partial grants for the construction of godowns (with or without village halls-*cum*-reading rooms) and in specially deserving cases grants towards the cost of the staff required to run the societies for the first few years;

(5) Formation and encouragement of co-operative societies for consolidation of holdings; and

(6) Improvement of livestock.

An experimental scheme of intensive rural health work in a group of 25 villages round about Poonamalle was started in October 1935, financed partly by the Government of India and partly by the Rockefeller Foundation. The subvention from the Foundation was withdrawn at the end of five years and the scheme is now run entirely with the aid of the Government of India grant. The object of the scheme is to educate the ryots in the art of healthy living, to teach them that disease is preventible and, in a word, to make them 'health-conscious'. The health unit is in charge of every aspect of public health in the area, including vaccination, vital statistics, health education, maternity and child welfare and sanitation including water supply.

Prohibition has been introduced in the districts of Salem, Chittoor, Cuddapah and North Arcot. In these districts the organization of sports and amusements as a counter-attraction to drink has been combined with a rural uplift drive. Rural uplift schools have been held to train rural uplift workers, or village guides and physical instructors have been appointed to control and coordinate the activities of these guides. Special Development Officers have also been appointed for tackling more effectively the social and economic problems that have arisen in these districts as a result of the abolition of drink and for building up a programme of life for the villagers, which is both utilitarian and attractive.

Rural indebtedness

The Madras Agriculturists Relief Act, 1938, which came into force on 22 March 1938, provides for relief of indebtedness among agriculturists. To enable them to have their debts scaled down under this Act without the trouble and expense involved in going to civil courts, the Government have established under the Madras Debt Conciliation Act, 1936, 92 debt conciliation boards generally at the rate of one for each revenue division.

In order to afford sufficient credit to agriculturists after the passing of the Madras Agriculturists Relief Act, the Government have removed the ban on the registration of a large number of societies. The number of societies registered in 1939-40 was 932 against 828 in 1938-39 and 446 in 1937-38.

The Government have introduced a comprehensive scheme of rural water supply with a view to making pure drinking water available to the people in every village in this province.

In 1924, the Government inaugurated a scheme for opening subsidized rural dispensaries with a view to bringing medical relief within easy reach of the rural population. Under the scheme qualified practitioners of western and Indian systems of medicine are given small subsidies as an inducement to settle down in selected villages and set up private practice. The liability of the Government on account of the scheme is restricted to the payment of subsidy for the medical practitioner and midwife. The cost of medicines and other contingent charges are met by the local boards concerned. The grant of subsidy is subject to the condition that the medical practitioner should treat the necessitous poor free. The practitioner is at liberty to accept such fees for medical attendance and medical treatment as he can get from well-to-do patients. Some of the rural dispensaries are maintained entirely from the funds of local boards. The number of rural dispensaries working at the end of 1940 was: 89 maintained entirely by the local boards and 435 subsidized by Government. The Madras Public Health Act, 1939, is a very important measure and the first of its kind in India. Though the Act provides for the advancement of public health in the whole of this province, it will be particularly helpful in improving public health in rural areas. Organized propaganda undertaken in collaboration with private and public effort with a view to giving publicity to the Act and its provisions is expected to have far-reaching results.

Village communications

The Government have ordered the preparation by each district board of a well-defined five-year programme for the improvement of village communications in its area. Programmes from 21 district boards have already been received and approved. These programmes will ensure an orderly development of village roads and thereby lead to an improvement in the economic condition of the villagers.

A seven-year programme of road development estimated to cost Rs. 118·61 lakhs has been prepared. It consists of the more urgent and important schemes included in Mr Vipan's scheme of road development which was estimated to cost Rs. 6·12 crores. The seven-year programme is to be financed mainly from the subventions received by this Government from the Central Road Development Fund. The sanction of the Government of India has been obtained for the execution of most of the schemes included in the programme.

Two supplementary programmes of road development, one costing about Rs. 35 lakhs and the other about Rs. 65 lakhs, have also been prepared. They are also to be financed mainly from this Government's share of the Central Road Fund.

Relief of unemployment

With a view to providing relief of unemployment among the agricultural and labouring classes in areas affected by adverse seasonal conditions, the Government have issued instructions to the district boards exhorting them to undertake road works of permanent utility in the localities affected and to utilize their railway cess accumulations and general funds for the purpose. In cases where district boards are not able to take up such relief works without financial assistance, the Government give grants to the extent they consider necessary.

All local bodies have been requested while sanctioning works or when selecting for execution out of several sanctioned schemes to give preference to buildings, roads, bridges and other works which lie in areas affected by the failure of rain, so as to provide employment for labourers in those places. They have also been informed that when any work can be carried out by manual labour as well as by mechanical appliances which may displace manual labour, the object of providing (as far as possible and without detriment to the proper execution of the work) employment for manual labourers should be kept in view.

To improve the moral condition and the material prosperity of the people, the Madras Prohibition Act, 1937, has been enacted. The Act aims at the prohibition, except for medicinal, scientific, industrial or such like purposes

of the production, manufacture, possession, export, import, transport, purchase, sale and consumption of intoxicating liquors and drugs in the province of Madras. The Act has been in force in the Salem district from 1 October 1937, in the Chittor and Cuddapah districts from 1 October 1938, and in the North Arcot district from 1 October 1939.

The seasonal conditions during the current Fasli 1351 (1941-42) have not been very favourable and some distress has been reported in the districts of Bellary, Kurnool, Kistna, and West Godavari.

The Collectors of all the East Coast districts have been asked to get into touch with local boards and to undertake road works to provide employment where necessary. Road works have already been opened in the Kistna district, and at the request of the Collector of Kurnool the Government have permitted the District Board, Kurnool, to utilize a sum of Rs. 3 lakhs from the Railway Cess Fund for expenditure on the construction of 13 road works in the Kurnool district. Similar permission for the utilization of the railway cess amounts has been accorded in the case of the Kistna and West Godavari districts also.

Ten more road works have also been undertaken in the Kurnool district to provide employment for unskilled labourers. The District Board has been asked to meet the expenditure from the additional toll compensation sanctioned to it. In the Bellary district two test works were opened under the Famine Code in the middle of January and converted into relief works at the beginning of February. A third test work was opened at the beginning of February. Grain depots have been opened in the affected areas of the Kistna district.

Distress has also been reported in a number of districts among weavers due to fluctuations in the price of yarn and loss of markets and lack of shipping facilities. The Government of India have proposed a scheme for control of yarn distribution to stabilize prices. The Madras Government are examining it in consultation with Collectors. The Government have also opened weavers' relief centres in the Salem district and have sanctioned gratuitous relief to the unemployed weavers of Chingleput, Tinnevelly and North Arcot districts pending organization of the other relief measures. The Government are also examining the possibility of turning weavers of lungis whose markets have been affected by the War to production of other kinds of cloth for the Supply Department or for the local markets. The Government are closely watching the position of weavers in all districts and the Collectors have been instructed to consider departmental purchase of yarn and the formation of cooperative societies wherever possible.

Relief of indebtedness

Special provision has been made in the budget each year from 1938-39 onwards for the grant of loans to agriculturists for the relief of indebtedness. Special rules were framed with reference to the provisions of the Madras Agriculturists Relief Act, 1938, to regulate the grant of these loans and came into force on 1 October 1938.

The following are some of the special conditions applicable to the grant of these loans :

(1) Only agriculturists as defined in the Madras Agriculturists Relief Act, 1938, who own lands or the occupancy right in lands, the value of which, free of encumbrances, does not exceed Rs. 5,000, are eligible for loans under the scheme.

(2) Loans are granted only on the security of immovable property belonging to the applicant and to discharge either the entire debts of the applicant, or for a portion of the debts of the applicant, in cases in which the discharge of such portion of the debts would cancel the total encumbrance of a definite part of his property.

(3) In all cases, loans are granted only where the scaled down debt to be so discharged does not exceed Rs. 2,000 or fall below Rs. 100.

The rate of interest charged on such loans is the same as that charged on ordinary *taccavi* loans which is at present 6 per cent. The loans are repayable in equal annual instalments discharging both principal and interest. The first instalment is payable not later than twelve months from the date of disbursement of the loan. The loan should be repaid in not more than 20 instalments ordinarily or

30 in special cases, the number of instalments being fixed in each case by the Loans Officer with regard to the repaying capacity of the borrower.

The scheme has not been as successful as it was hoped it would be. The Government are examining suggestions to make it more popular and more useful to the agriculturists.

What the Scientists are doing

AGRICULTURAL SCIENCE

THE Section of Agriculture of the Indian Science Congress held its meetings at Baroda from the 3rd to the 6th January. During these four days some 25 papers were read and discussed, while another 35 papers were taken as read. In addition, three discussions were held jointly with other Sections, while one discussion was held in the Section itself. Dr Nazir Ahmad was the President and Mr N. L. Dutt the Recorder of the Section.

On the 3rd Dr Ram Das gave an account of his experiments in which very small quantities of solutions of certain salts influenced very considerably the rate of movement in soil columns. The causes responsible for this phenomenon have been ascertained and the practical application of the results were discussed. Another interesting paper dealt with the cultivation of *dalua* or summer paddy in Orissa in the shallow lakes and ponds in which water gradually recedes after the rains. It was stated that the coarse brown rice raised in this fashion caused stomach trouble to the well-to-do classes, but the tests carried out at Coonoor showed no difference in nutrition between this rice and the finer varieties.

In the afternoon a joint discussion was held with the Section of Mathematics and Statistics on the use of factorial and incomplete block designs in agriculture with Sir T. Vijayaraghavacharya in the chair. Among others, Dr V. G. Panse, Mr R. C. Bose and Mr R. S. Koshal read papers on different aspects of this question, which has important practical applications in laying down well-designed experiments for yield and variety trials or for studying the effects of manurial treatments, rotations, irrigations, etc.

Bag-o-molasses

On the 4th Mr S. E. Ray gave an account of the experiments on the use of bag-o-molasses as feed for cattle. Bag-o-molasses is prepared at the Imperial Institute of Sugar Technology, Cawnpore, from bagasse and molasses both of which are by-products of the cane sugar industry and are available in large quantities. It was observed that the use of this material induces diuresis, and therefore an extra amount of salt lick must be given to the cattle. Furthermore, since it has no digestible proteins, this deficiency must be made up by adding suitable proteins. It was suggested by the President that a balanced food containing a sufficient quantity of salt and digestible proteins might be prepared at the Institute for further trials on the farms. Another paper which evoked interest in discussion was also read by Mr S. E. Ray and dealt with the use of tree leaves as cattle fodder. The chemical composition of the leaves of several trees has been found and their use with reference to palatability to cattle was discussed. During this discussion attention was drawn by Dr Nazir Ahmad to the fact that a large amount of empirical knowledge on the merits of different kinds of tree leaves as cattle fodder and their long-range effects on cattle existed in the country and that attempts should be made to collect, sift and collate this knowledge so that it may be put to good and rational use. This suggestion was approved by the Section, and it was decided that it should be forwarded to the Imperial Council of Agricultural Research for necessary action.

Later on, a discussion was held jointly with the Section of Engineering on improvements of agricultural implements and machinery. The Dewan of Baroda, Sir V. T. Krishnamachari and Sir T. Vijayaraghavacharya, Dewan of Udaipur (Mewar) were present at this discussion. Dr Pandya, President of the Engineering Section, said that in effecting any improvements in agricultural machinery and implements the conditions that should be borne in mind are the poverty of the Indian cultivators, the small size of the average holding and lack of vocational education among the rural population. Mr B. M. Lakshmipathy, Agricultural Research Engineer, Coimbatore, gave an account of several

new implements which had been designed at Coimbatore and are now being taken up not only in Madras but in other provinces. These implements included roll-easy *mhote* wheel, puddling and trampling implements, turmeric polisher, and groundnut decorticator. Mr R. G. Allan, Commissioner of Agriculture, Baroda, said that in designing agricultural implements for Indian conditions the two factors which should be constantly borne in mind are (*a*) simplicity of design and (*b*) multiple utility. He gave several instances in which neglect of either factor had produced unsatisfactory results. Sir T. Vijayaraghavacharya was of the opinion that large-scale mechanization of the agricultural areas should not be adopted blindly as it might lead to large-scale unemployment of the rural population. Dr Nazir Ahmad, in winding up the discussion, pointed out that as the pressure on land was increasing rapidly and sufficient food was not available for a large section of the population, the use of heavy machinery might be resorted to for opening up new tracts and for increasing the yield from comparatively large holdings.

Cold storage of potatoes

Among the papers read on the forenoon of the 5th mention may be made of a paper by Mr D. H. Jani on the ecodairy problem of India in which an improved method for the manufacture of ghee was described, a paper by Mr G. S. Kulkarni on cold storage experiments with potatoes which have practical significance at the present time owing to the shortage of potato seed for cultivation, a paper by Mr H. Navkal and Dr Nazir Ahmad on the prediction of spinning value of cottons from their fibre properties and another paper by Mr R. L. N. Iyengar and Dr Nazir Ahmad on the determination of the maturity coefficients for Indian cottons. An interesting paper was read by Messrs T. H. Carpenter and C. J. Harrison of the Indian Tea Association in which they gave an account of the effects of long-term manurial treatments on the yield of tea and on the composition of the soil. It was found that among the inorganic fertilizers, ammonium sulphate was much superior to nitrate of soda which after some years caused harmful effects including reduction of soil acidity and soil tilth. Among the organic manures rape-cake gave on the whole the best results, while the animal organic manure (sinews) proved consistently inefficient.

On the afternoon of the same day a joint discussion was held with the Section of Botany on the control of weeds with Dr N. L. Bor, President of the Botany Section, in the chair. Prof. P. Parija spoke on the control of aquatic weeds such as water hyacinth. The life-history of these weeds has been studied in order to discover weak points in their life cycle, so that an attack might be delivered at those stages. Water hyacinth spreads rapidly by vegetative means and also propagates by seed. The seeds require a period of rest and alternate soaking and drying before germination. Among the weeds which float in masses in the Chilka lake and harbour mosquito larvae, potamagetan has two seasons of growth in the year, which are correlated to the salinity of the lake water. Higher salinity seems to control weed growth. Prof. B. N. Singh gave an account of the different methods of weed control. Mr N. S. Joshi referred to the weed problem in the Deccan Canal areas and Mr N. L. Dutt gave an account of the control of striga which attacked the young sugarcane seedlings in the nursery at Coimbatore.

On the 6th Mr S. S. Bhat of Baroda gave an account of his experiments on the manufacture of different articles from lime. He explained that in addition to lime juice, other articles including a metal polish had been prepared from this fruit in such a manner that every part of it was utilized in one way or another and that if the Indian cultivator or a small industrialist took up this work, he could obtain a good profit on this crop. Dr Badami gave an account of his observations on the peculiar behaviour of the turmeric plant which, sown under comparatively dry conditions, throws off a kind of tumour for storing water.

Utilization of research

Later on an interesting discussion was held on the utilization of the results of agricultural research for increased monetary return to the cultivator. Mr P. M. Kharegat, Vice-Chairman, Imperial Council of Agricultural Research,

had kindly come down to Baroda for this discussion and presided over it. Among those present were Sir V. T. Krishnamachari, Dewan of Baroda, and Mr D. N. Wadia, General President of the Science Congress. In initiating the discussion, Mr Kharegat said that before recommending results of any particular research to the cultivator it must first be seen if the research is utilizable under the conditions obtaining in the cultivators' fields. For this purpose it must be determined whether the results are economically profitable under cultivators' conditions. Next a detailed schedule of instructions should be drawn up to suit different local conditions. In making recommendations to the cultivators the demonstration staff should bear in mind their suitability or applicability to the ryot's conditions. A suitable area should be selected for work and a quantitative plan drawn up. Thereafter demonstration and propaganda should be carried out in the selected area. The demonstration staff should be specially trained for propaganda work. The villagers must be organized cooperatively or otherwise; it is easier to deal with organized bodies than with a large collection of individuals. As regards the question of finance it should be remembered that if a thing is economically profitable the cultivator takes it up readily, and is somehow able to find the money, though finance has to be arranged in many cases. Finally, suitable arrangements have to be made for marketing. A recommendation was once made about the growing of sweet potatoes as it was said that it would give a profit of Rs. 128 per acre. An old cultivator got up and asked whether if everyone was to grow sweet potatoes, would he then get the same profit or return per acre. That is the crux of the problem. There are bound to be difficulties unless prices can be stabilized or production adjusted to demand. Mr Kharegat concluded by saying that we would not succeed so long as stress is laid on one or two items of improvement. The recommendations should be treated as a complete whole, and all aspects borne in mind. Research and development must go hand in hand, the ultimate object of both being the welfare of the people.

Organization needed

Mr K. Ramiah represented the viewpoint of the plant breeders and emphasized the necessity of setting up some sort of organization by which the results of research are passed rapidly to the cultivators. Mr R. G. Allan said that research must be regarded as the spearhead behind which there must be an efficient organization and good financial support. He instanced the useful work done by the Indian Central Cotton Committee and also explained in detail the system followed in Baroda whereby the results of research are propagated rapidly and over a fairly large area of the state among the cultivators who are also provided with technical advice and necessary machinery on part payment for adopting modern agricultural practices. Mr Carpenter of the Indian Tea Association gave several instances in which the results of research obtained at the experimental farm had been quickly utilized by the tea growers to their great and lasting benefit. Prof. Parija spoke on behalf of the middle-class cultivator and explained the difficulties encountered by him in quickly obtaining improved seeds for his farm. He emphasized the necessity of setting up some organization between the central research organization and the middle-class cultivators by which this difficulty may be obviated in future. Dr H. K. Sen spoke on the subject with reference to lac 97 per cent of which was exported. He explained that the cultivator often had to cut the crop immature and lose 25 per cent of the profit and that by propaganda and education this loss could be avoided. Sir V. T. Krishnamachari said that in his opinion the state should take up the responsibility of multiplying improved seed and supplying it to the farmer. As regards the cultivators' readiness to take up improved methods of agriculture or obey acts and legislative measures bearing on the cultivation of crops, he was of the opinion that the cultivator is ready to do so provided it is found remunerative. In Baroda they had found no difficulty as the work done by the Department of Agriculture had prepared and educated the cultivator. It was possible in many cases to pass the acts and rules and enforce them in a very short

time with the willing cooperation of the growers. With regard to the supply of improved seed, Dr Nazir Ahmad said that the question of disposal of old seed from the cultivators should also be considered, because, left to themselves, the farmers were inclined to use inferior seed rather than obtain improved seed. He also suggested that any organization which may be set up for conveying the results of research to the cultivators should take into account the enlightened and large estate holders such as the tea growers as well as the uneducated and small farmers possessing very small holdings. In closing the proceedings, Mr Kharegat said that the discussion had brought out some very interesting points and in particular it was necessary for research workers to ascertain the problems of the cultivators and find out what they needed. The whole subject was under the consideration of the Imperial Council of Agricultural Research.—(N. A.)

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INDIAN LINSEED FLAX

CULTIVATION of linseed in India exceeds four million acres, yielding on an average 410,000 tons of oilseeds. But the straw amounting roughly to 1,500,000 tons obtained from the same crop is either burnt or thrown away as waste material. This straw is capable of yielding about 300,000 tons of flax and it is therefore a great waste to allow such a large quantity of flax to be burnt instead of utilizing it as a source of useful fibre, to the mutual benefit of industrialists and cultivators.

The Central Provinces is the chief producer of this crop occupying over 1,300,000 acres. Any advance towards utilizing the linseed straw will, therefore, directly benefit this province in particular. Experiments on the utilization of this material have been in progress since 1937 at the Oilseeds Research Laboratory, Nagpur, financed by the Imperial Council of Agricultural Research. These investigations have established beyond doubt that the Indian linseed plant is capable of yielding high quality fibre which may provide the basic raw material for the establishment of a number of industries such as the manufacture of textiles, artificial silk, paper-making, etc. These efforts have, therefore, opened up a new field for the industrial development of this province. It has been estimated that the Central Provinces and Berar alone are capable of producing nearly 1,000,000 bales of linseed fibre of 250 lb. each annually.—R. H. RICHHARIA, Oilseeds Specialist, Nagpur.

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q : Do lice found on poultry suck blood ? If not, why do I find my chickens rapidly losing condition when they are heavily infested with these parasites ? Is there any satisfactory method of controlling them ?

A : No, poultry lice do not suck blood. As a matter of fact, blood-sucking lice, such as the head louse of man, do not occur on birds, but only on mammals. On the other hand, biting lice, such as those which are found on poultry, infest both birds and mammals. Poultry lice live on pieces of feather and scales from the skin. When in large numbers, they cause considerable irritation by incessantly gnawing at the skin and, in consequence, the infested birds become restless and unthrifty, their development is retarded and the egg production reduced. A simple but effective remedy against these parasites is to dust *all* birds of an infested flock with commercial sodium fluoride. A single application of about twelve pinches of this powder, distributed under the feathers all over the body, is usually sufficient to effect a cure. Young chickens require only one pinch. The powder is best applied in the morning, so that the excess of it may be shaken off by the birds before roosting time. Care should be taken that the powder does not get into the food or water.

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Q : Will you please tell me what is redwater of cattle and why it is so called ? Is it a serious disease in India ? What are the best measures for its control ?

A : Redwater is a common disease affecting cattle and is characterized by fever, anaemia, jaundice and the passing of red-coloured urine, the last being the most striking symptom, and it is to this that the disease owes its name. The disease is caused by a minute parasite (known as *Babesia bigemina*), somewhat resembling the malaria parasite of man. It invades the red corpuscles of the blood, eventually destroying them and causing some of their red colouring matter (haemoglobin) to be liberated whence it passes out in the urine. However, the passing of urine, which is obviously blood-tinged, although it is a characteristic symptom of the disease, does not occur in all cases.

In India, the country-bred stock acquire infection as calves, which are more resistant to redwater than adult animals. The parasites then remain in their blood, in a so-called latent state, as long as the animals live. Cattle imported into India from localities where redwater does not exist are very liable to contract the infection, whilst adult cattle, which are indigenous to India and harbour the latent parasites, get the disease when their resistance to it is broken down as a result of other diseases, such as rinderpest.

The drug known as Acaprin is a good remedy for redwater when it is injected subcutaneously at the rate of 1 c.c. of a 5 per cent solution for each 100 lb. body-weight of the animal. Trypanblue has also been used with apparent success in treatment.

Redwater is definitely known to be transmitted by the common cattle tick (*Boophilus australis*). Cattle should therefore be protected from these ticks by the use of suitable sprays and dips.

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Q : I have a daily surplus of 200 lb. of skim milk (buffalo's). Please send me instructions for the manufacture of casein. Where can I sell it ?

A : *Method of making casein* : Three kinds

of casein are made, viz. (1) lactic, (2) rennet and (3) acid. The cheapest is the lactic type, but it gives the poorest product. As the quantity of 200 lb. of skim milk is too small to permit of profitable manufacture of rennet and acid caseins, it is suggested that lactic casein be made. For this, fresh, and practically fat-free and clean separated milk should be placed in a vat (preferably wooden). The temperature should be brought to 100°F. Starter (previous day's whey or curdled separated milk) should be added at 2 to 5 per cent, thoroughly mixed in and the vat covered and milk allowed to curdle overnight. The curdling should be carried further by allowing the curd to separate out from whey. The whey should be removed. The casein should be washed as much as possible with warm water (110°F) first, followed by two washings with cold water. The green casein should then be transferred to a hand screw wooden press between sacks and pressed for 2 to 3 hours. The pressed casein should be screened through a wire gauze and then dried on clean cloth in the sun. The finished product is granular and pale in colour.

Yield of casein : The yield differs according to the process employed and depends on the initial casein content of the separated milk. Ordinarily a yield of between 2·7 and 3 per cent may be expected.

Where to sell casein and the best price obtainable : (1) Messrs Polson Model Dairy, Anand ; (2) Messrs Doshi Brothers, Casein Manufacturers, Balej, *via* Anand ; (3) The Parisian Dairy Co., No. 1 Tamarind Lane, Fort, Bombay; (4) Messrs Edward Keventer Ltd., Dairy Farm, P. O. Aligarh ; (5) R. E. I. Dairy, Dayalbagh, Agra.

The price of lactic casein before the war was about Rs. 140 per ton, the highest then being about Rs. 260. Due to the present international situation, and the increased demand against the same output, the price has now risen to as much as Rs. 400 per ton for good quality casein.

INFORMATION PLEASE

The Agricultural Commissioner, Imperial Council of Agricultural Research, New Delhi, will be grateful if growers of tomatoes anywhere in India will send to him their experience regarding a disease of tomatoes which in certain years causes the leaves to become dwarf and crinkled and reduces the fruiting considerably. A badly affected plant is almost unrecognizable as a tomato plant since it becomes a compact mass of dense small leaves.

In the current year, this disease has been very bad in certain gardens in New Delhi. On the other hand, it was not noticeable in scattered plants which had accidentally grown in other parts of affected gardens mixed up with other vegetables or in flower beds.

At a garden in Bhagalpur in Bihar, there was almost no attack although a few branches of certain plants showed symptoms.

What's doing in All-India

GROW MORE FOOD

By D. N. Mahta, B.A. (Oxon)

Secretary, Indian Central Cotton Committee, Bombay

A MATTER of the utmost importance, having far-reaching consequences for the cotton grower in particular, and the Indian cotton industry in general, which engaged the attention of the Indian Central Cotton Committee at its meeting held in January 1942, was that relating to the question of the curtailment of area under short and fair staple cotton for which there is no market at present.

Loss of markets

The position of Indian cotton, arising from the loss of European markets as a result of the war, was first examined by the Indian Central Cotton Committee at its meeting held in January 1941. The extent of the loss was then estimated at 859,000 bales, on the basis of the average annual exports of Indian cotton (mainly Bengals, Oomras, Dholleras and Comillas) during the three seasons ending 31 August 1939. The general view of the Committee was that the surplus of short staple cotton was not likely to be reduced materially by the increased activity of the Indian mill industry and that the most direct way of tackling the problem lay in the curtailment of area under such cottons. It was accordingly decided that the views of the provincial Governments should be ascertained regarding the feasibility of giving effect to this proposal. The replies received from the provincial Governments were considered by the Committee at its meeting held in January 1942, and a very interesting debate, lasting over nearly two days, took place.

Grave situation

It was observed that, while in 1941, when the question of the disposal of the surplus Indian short staple cotton was first considered by the Committee, the problem was one of the disposal of about 8½ lakhs of bales of cotton. With the entry of Japan into the war the position had considerably worsened, and the country was now faced with the problem of finding a market for about 17 lakhs bales of short and fair staple cotton, comprising the whole of the Oomras (excluding Jarila and Verum), Bengals, Comillas, Hyderabad Westerns, Cocanadas and Warangal, Central India (excluding Malvi), Mathia and Broach short staple cottons. There was general agreement that the oft-repeated plea, that unless an alternative cash crop could be suggested to the cultivator it was not practicable to persuade him, to any appreciable extent, to grow substitute crops no longer held; as the position had now arisen when uncontrolled production of short staple cotton was an uneconomic proposition and, to that extent, such cotton had ceased to be a cash crop. After very careful consideration of the matter, the Committee came to the conclusion that the only rational way of dealing with the problem was to curtail the area under such cotton, and a reduction of 50 per cent in the acreage under short and fair staple cotton was suggested.

Substitute crops

This led to the consideration of the question as to what should be recommended to the cultivator as an alternative to the growing of short and fair staple cotton. The consensus of opinion in this connection was in favour of the cultivation of food grains, except in areas where another crop may be considered more suitable by the local Agricultural Department. It was emphasized that the production of food grains was a matter of national importance, not only for the support of the agricultural population of the country but also for meeting the extensive requirements of the Defence Services both in India and abroad, for some time to come. Attention was drawn to the

fact that, while the population of India had increased considerably since the last census, the cultivated area had only increased by about 1 per cent ; the area under rice had not increased at all and the country was now dependent on outside rice to the extent of about 2½ million tons per annum.

Need for more food

The problem was aggravated by the cutting off of the import of rice from Burma and that, therefore, apart from any question of persuasion or compulsion, the pesent was a most suitable opportunity for the people to take to food crops. In suggesting that special attention should be devoted to the growing of food and fodder crops, in preference to other crops, the Committee had in mind such contingencies as the failure of the monsoon during the period of the present emergency when, owing to transport difficulties, the food position of the country might become very serious through lack of adequate facilities for the movement of food grains from the non-affected to the affected areas. The Committee felt that, if the position were placed before the cultivator in its true perspective and suitable propaganda were undertaken as regards the outlook for short and fair staple cotton, he would not be slow to appreciate the importance of the change over suggested. After a lengthy debate, during which every aspect of the question was fully examined, a resolution of which the following are the main portions was unanimously passed by the Committee :

Reduction of cotton acreage

In view of the necessity and urgency of avoiding any further glutting of the Indian cotton market with short and fair staple cotton hereafter, the buyers of which have been cut off from the Indian market owing to the present hostilities which may run for a period which cannot be estimated at present, the Indian Central Cotton Committee requests the Government of India to urge all provincial Governments and states in India, especially those in areas where short and fair staple cotton is being grown, to reduce the existing acreage under such cotton forthwith by at least 50 per cent. As alternative to short and fair staple cotton, such other crops may be encouraged as may suit the conditions of each area, preference being given to food grains, adequate stocks and reserves of which will continue to be a matter of vital national importance for a number of years to come. To stimulate and accelerate such change provincial Governments and states should be urged to subsidize the same by such means as may be most effective according to local conditions in each province and state, including the supply of free or cheap seeds and the provision of funds and facilities for the sinking of new and the repair of old wells.

Early action

While realizing that the provincial Governments, in touch with the local conditions, are in the best position to decide what means should be adopted for attaining the object in view, the Committee desired to recommend, as possible lines of action, the supply of free or cheap seeds, the provision of funds and facilities for the sinking of new and the repair of old wells, remission of land revenue and postponement of the date of its payment or a cash subsidy for such acreage as is transferred from cotton to food crops. The need for ensuring that the curtailment of acreage in one province would not be accompanied by an increase of acreage in another was stressed and, in order that the cultivator may receive due warning of the impending change, it was emphasized that such action as provincial Governments propose to take on the recommendations contained in the above resolution should be notified as early as possible, i.e. in good time before the next sowing season.

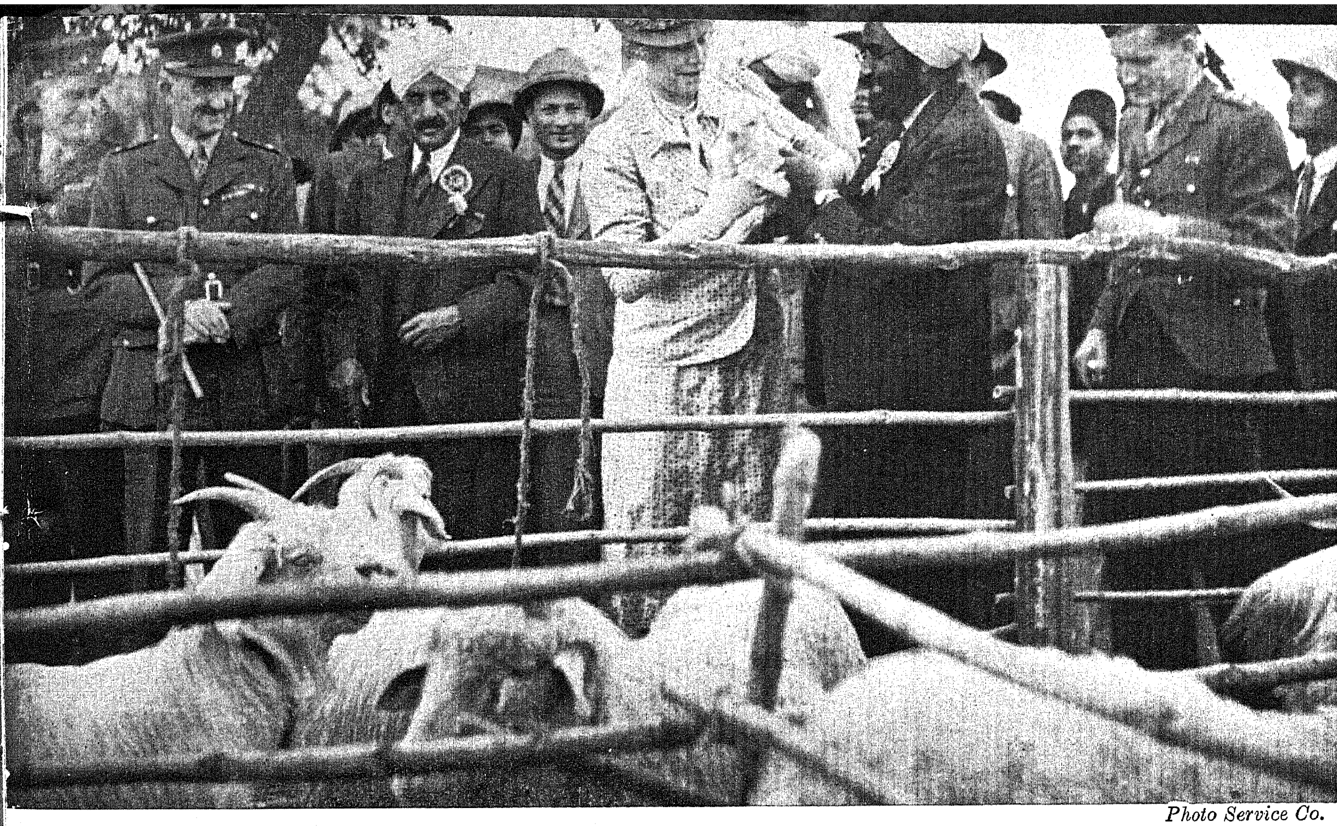


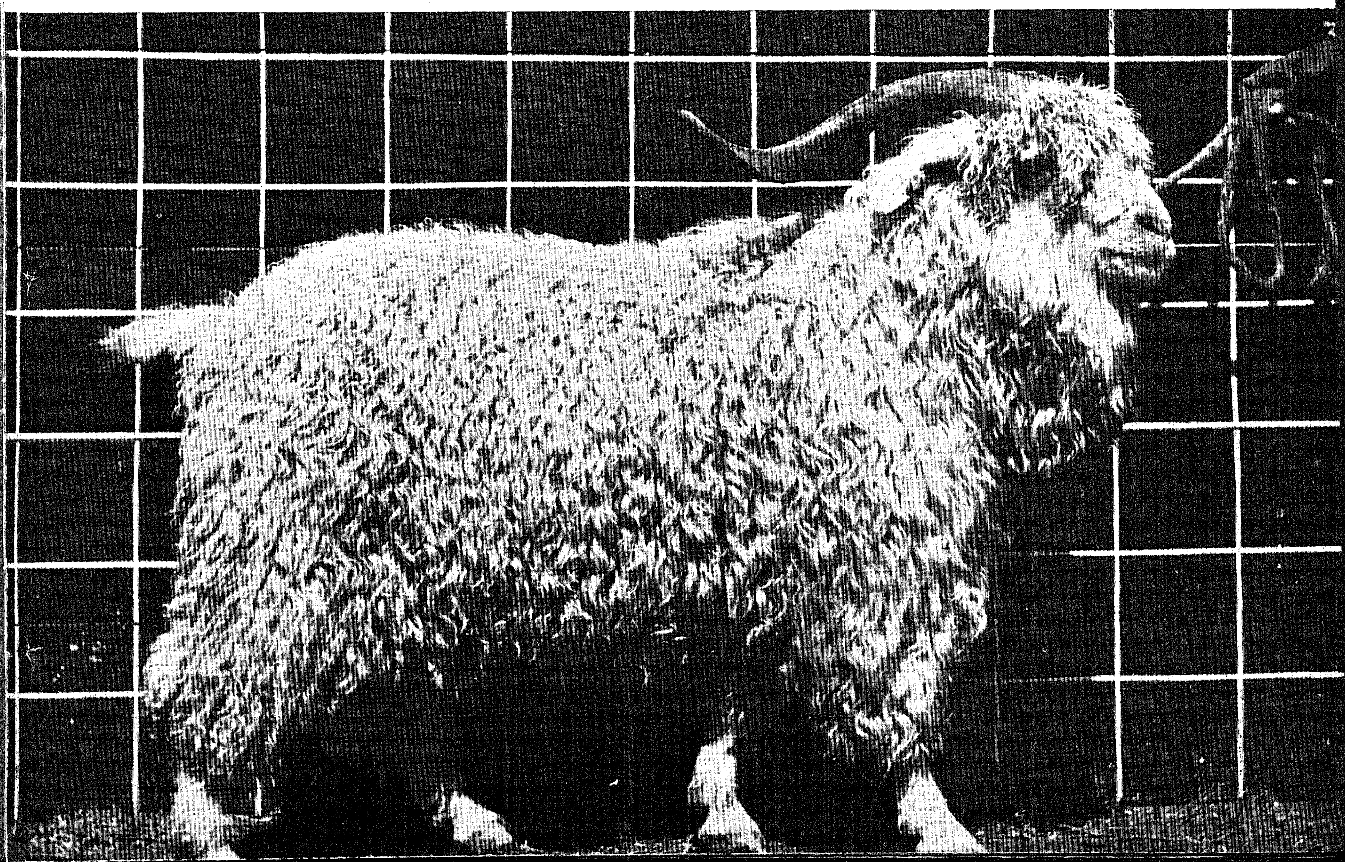
Photo Service Co.

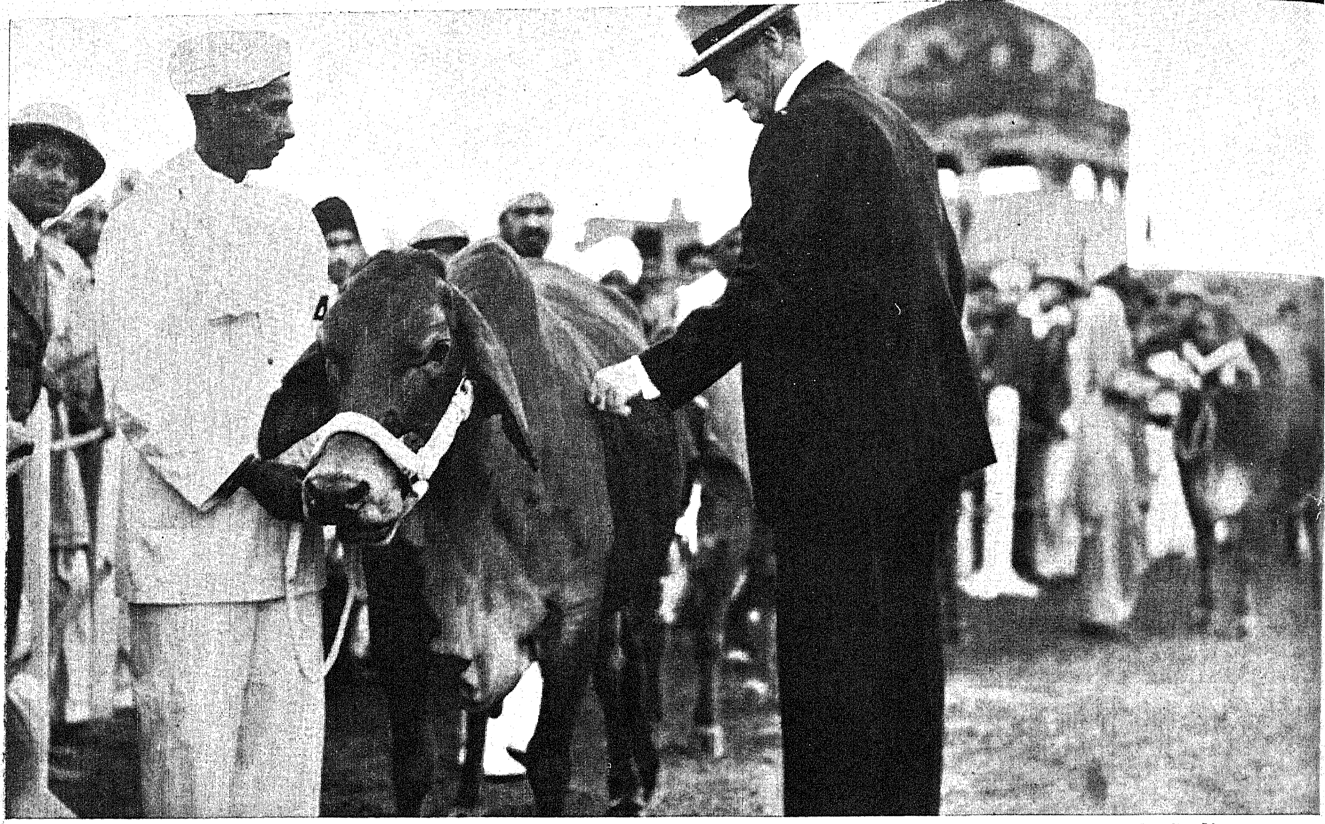
Her Excellency examining a cross-bred kid, son of the Angora ram, 'Mortimer', out of a Simla hill nanny goa

PLATE 56

Of exceptional interest, the Angora ram, Mortimer, property of Major W. S. Read of the Hissar Cattle Farm.

Photo Service Co.





Simla Studios

H. E. the Viceroy examining Mudini, the champion of the Show. She was entered by the Military Dairy Farm, Ferozepur

PLATE 57

H. E. the Viceroy having a chat with Khan Sahib Dost Mohammad Khan of Jahangirabad

Photo Service Co.

THE FIFTH ALL-INDIA CATTLE SHOW

By F. M. de Mello, B.A., B.Sc. (Econ.)
Editor, Imperial Council of Agricultural Research

A CATTLE show in Delhi, the culminating stage of two regional shows held at Bhavnagar and Bangalore, organized with great attention to detail in the midst of a growing momentum of war activities in the capital, is an outstanding achievement of which the All-India Cattle Show Committee may well be proud. From the south and west cattle, adjudged to be the best of their class, came in to take their place alongside the northern breeds and receive their due awards. Both in conception and in execution, the scheme for regional and central shows could not fail to impress the visitor with the wealth and variety of India's livestock. Only the enthusiasm of exhibitors, transport agencies and the Committee's officials could have made this magnificent show possible under present circumstances. The show, which was held from 16 to 21 February, attracted a good many visitors.

Owing to the elimination of unsuccessful exhibits at Bhavnagar and Bangalore, there were only 710 cattle and buffaloes at this year's show as against the record of 819 of last year. Though smaller in number, the entries were distinctly better in quality, and the experts noticed an all-round improvement among prize-winners. Interest this year was further enhanced by the appearance for the first time of sheep and goats of which quite a large variety were in evidence. Sheep- and goat-breeding thus received the recognition due to an industry of growing importance. As last year, there was a poultry show held in conjunction with the Cattle Show, and the many varieties of poultry, some of them of gorgeously coloured plumage, attracted considerable attention.

Representation of breeds

The main breeds of cattle represented at the show were the Bhagnari, Dhanni, Gaolao, Hariana, Hissar, Lohani, Malvi, Mewati, Nagori, Nimari, Rath and Sahiwal, together with Murrah, Nili and Ravi buffaloes. There were Balkhi, Bikaneri, Hashtnagri, Lohi, Barbari, Daira Deen Panah, Jamnapari and Sirli sheep and goats. Some crosses of Angora goats from Hissar had also been brought to the show, and they attracted many visitors on account of their heavy, lustrous fleece. The poultry breeds included Rhode Island Reds, White Leghorns, Black Minorcas, Australorps and Orpingtons, Bantams, Chittagongs, Aseels, and also the humble *desi* fowl.

The spirit of competition is spreading in the countryside, for the judges had in many cases great difficulty in coming to a decision on the merits of rival animals. This is as it should be, for the chief aim of the cattle show is the improvement of livestock, and this can hardly be done without effort on the part of stock-breeders. To them, apart from the valuable cups and cash prizes to which they aspire, the gratification they feel at the appreciative comments of judges and the increase in stature on return to their homes must be fair reward. Cattle shows enable the cultivator to realize that the country appreciates their work in breeding good animals. Nor is this all. The cattle-breeders who assemble at Delhi have the unique privilege of meeting their confreres from other parts of India and of comparing notes and exchanging information. In this respect the educative value of the All-India Cattle Show has increased each year.

Champion of the show

Mudini, the Sahiwal cow entered by the Ferozepur Military Dairy Farm was again held this year to be the best animal of the show. She won the milking competition with a yield of $47\frac{1}{2}$ lb. in 24 hours: she also took four other prizes. The prize for student judges was won by the Allahabad Agricultural Institute, which sent a strong team this year. The bullock cart presented by the Indian Roads Congress was won by Surya of Bharatpur with a pair of magnificent Nagori bullocks.

The new prizes given away this year were

the Madan Mohan Lal Challenge Cup for the best general utility cow presented by Lala Shankar Lall, Member of the Committee; the Raja Sultan Lal Hussain Khan Challenge Cup for the best Murrah heifer presented by the District Board, Rohtak; the Sir Hormasji Cawasji Dinshaw Challenge Cup for the highest milk-yielding buffalo cow presented by Mr Nusserwanji H. C. Dinshaw, Bombay; the Yeatts Challenge Cup for the best Sahiwal young bull presented by Mr M. W. M. Yeatts, C.I.E., I.C.S., Census Commissioner; and the Zal R. Kothavalla Challenge Shield for the highest milk-yielding animal in the show, by Mr Zal R. Kothavalla, Director of Dairy Research.

Valuable prizes

In addition to the cups, cash prizes of the total value of Rs. 10,240 were given to exhibitors, and a sum of Rs. 1,100 was given away as consolation prizes to the owners of animals which did not win a prize. The cash prizes for poultry amounted to Rs. 552-8, together with cups of an equal value.

His Excellency the Viceroy and the Marchioness of Linlithgow visited the Show on the 18th, and were keenly interested in the exhibits. Owing to bad weather on the last day, His Excellency was unable to distribute the prizes, and in his absence, they were given away by Mr F. Ware, Animal Husbandry Commissioner with the Government of India. The prizes for poultry were distributed on the 18th by the Hon'ble Mr N. R. Sarker, Member for Education, Health and Lands of the Government of India and President of the All-India Cattle Show Society.

PRIZE-WINNERS AT THE ALL-INDIA CATTLE SHOW, 1942

SINGLE BREED CUPS

Donor	Cup and Event	Winner	Cash Prize Rs.
H. H. The Raja of Faridkot	The Faridkot Challenge Cup for the best Dhanni bull *	Karam Ali S/o Lal of Khewal, Rawalpindi	100
Sir Muhammad Nawaz, Kot Fateh Khan	The Kot Fateh Khan Challenge Cup for the best Dhanni cow	Asghar Khan S/o Akbar Khan of Robal, Rawalpindi	50
The District Board, Rohtak	The Sir Chhotu Ram Challenge Cup for the best Hariana bull	Tara Chand S/o Kalu, Village Khanpur (Rohtak)	100
Raja Durga Singh Ji, Baghat	The Baghat Challenge Cup for the best Hariana cow	Raja Ram S/o Ram Dayal, Village Maraut (Rohtak)	50
The District Board, Rohtak	The Dalpat Singh Challenge Cup for the best Hariana heifer	Government Cattle Farm, Hissar	..
		Sarupa S/o Nanda, Village Asanda (Rohtak)	50
The District Board, Rohtak	The Sir Henry Craik Challenge Cup for the best Hariana young bull	Government Cattle Farm, Hissar	..
		Gordhan S/o Ramji Lal of Mubarakpur (Delhi)	50
Ingram Skinner Estate, Palwal, Punjab	The Quirke Challenge Cup for the best Hissar bull	Government Cattle Farm, Hissar	..
		Birkha S/o Neki Nonand (Rohtak)	100
Shriman Rao Raja Bahadur of Sikar (Rajputana)	The Sikar Challenge Cup for the best Hissar cow	Suleman S/o Gehna of Lakhewali, Distt. Ferozepore	50
Cattle Breeding Association, Tehsil Bhiwani, Hissar	The Sir Chhotu Ram Challenge Cup for the best Hissar heifer	Sada Ram S/o Tabu Ram of Hissar	50
Thakore Nahar Singh Khirwar, Landlord and Rais, Kuarsi (Distt. Aligarh)	The Thakore Nahar Singh Khirwar Cup for the best Kherigarh cow	Not to be awarded (Government Animals)	..
H. H. The Maharaja, Jodhpur	The Jodhpur Challenge Cup for the best pair of bullocks of Nagori breed	Surja, Bharatpur	100
Shriman Rao Raja Bahadur, Sikar (Rajputana)	The Sikar Challenge Cup for the best Nagori cow	Niwaj Khan, Belung, (Kaman)	50
H. H. The Raja Sahib, Keonthal	The Keonthal Challenge Cup for the best Sahiwal bull	K. S. Dost Mohd. Khan, Prop., Cattle Farm, Jahangirabad, Distt. Multan	100

***With Midiature.**

SINGLE BREED CUPS—*contd.*

Donor	Cup and Event	Winner	Cash Prize Rs.
Mr M. W. W. M. Yeatts, Census Commissioner of India, Simla	The Yeatts Challenge Cup for the best Sahiwal young bull	Ch. Shauq Mohd. Khan, Prop., Allahabad Cattle Farm, Distt. Multan	100
H. H. The Nawab Ruler Bahadur of Bahawalpur	The Bahawalpur Challenge Cup for the best Sahiwal cow *	Military Dairy Farm, Ferozepore	..
		S. B. Sir Datar Singh, Prop., Montgomery Dairy Farm, Montgomery	50
S. Harinder Singh Sandanwalla, Rais of Raja Sansi, Amritsar	The Sandanwalla Challenge Cup for the best Sahiwal young cow	Ch. Shauq Mohd. Khan, Prop., Allahabad Cattle Farm, Distt. Multan	50
The Hon'ble R. B. Ram Saran Das, Lahore	The Ram Saran Das Challenge Cup for the best Sahiwal heifer	The Imperial Agriculturist, I.A. R.I., New Delhi	..
		Ch. Shauq Mohd. Khan, Prop., Allahabad Cattle Farm, Distt. Multan	50
The District Board, Lyallpur .	The Lyallpur District Board Challenge Cup for the best Murrah bull	Siri Chand S/o Molar, Gadi-Kheri (Rohtak)	100
S. B. Sobha Singh, Rais and Landlord, New Delhi	The Sobha Singh Challenge Cup for the best Murrah cow	Dina S/o Mehdi Hussain, Kalanaur (Rohtak)	50
The District Board, Rohtak .	The Raja Sultan Lal Hussain Khan Challenge Cup for the best Murrah heifer	Pinjrapole Society, Delhi .	50
Ch. Sohan Lall, Member, Distt. Board, Ferozepore	The Walker Challenge Cup for the best Nili bull	S. B. Sir Datar Singh, Montgomery Dairy Farm, Montgomery	100
The District Board, Ferozepore .	The Amin-ud-Din Challenge Cup for the best Nili cow	Nadhan Singh Rais S/o Ram, Fazilka	50
Mian Mohd. Zarif, Tehsil Chunian, Distt. Lahore	The Sir Chhotu Ram Challenge Cup for the best Ravi bull	Gian Chand S/o Mohan Lal, Distt. Amritsar	100
S. Nand Singh and L. Chuni Lal Distt. Lahore	The Sir Sikandar Hayat Challenge Cup for the best Ravi cow	Harnam Singh of Chak 94/6R, Distt. Montgomery	50

BREED CHAMPIONSHIP CUPS

Donor	Cup and Event	Winner	Cash Prize Rs.
The Times of India, Bombay .	*The Times of India* Challenge Cup for the best animal of Bhagnari breed	Vety. Supdt., Khairpur State, Khairpur Mir's, Sind	..
The District Board, Mianwali, Punjab	The Mianwali Distt. Board Challenge Cup for the best animal of Dhanni breed	Ujjal Khan S/o Haider Khan of Robbal, Rawalpindi	100
Pt. Kultilak Raj, Amritsar .	The Walker Challenge Cup for the best animal of Hariana breed	Government Cattle Farm, Hissar	..
Employees of the Government Cattle Farm, Hissar	The Banford Challenge Cup for the best animal of Hissar breed	Suleman S/o Gehna of Lakhewali, Distt. Ferozepore	100
H. H. The Nawab of Bhopal .	The Bhopal Challenge Cup for the best animal of Malvi breed*	Gokal, Raipur (Bhopal) . .	100
H. H. the Maharaja of Alwar .	The Alwar Challenge Cup for the best animal of Mewati breed	Rampertap, Alwar . . .	100
H. H. the Maharaja of Jodhpur	The Jodhpur Challenge Cup for the best animal of Nagori breed	Niwaj Khan, Belung, (Kaman)	100
H. H. the Maharaja of Holkar, Indore	The Holkar Govt. Challenge Cup for the best animal of Nimari breed	The President, The Taluka Development Agril. Assoc., Jalgaon	100
H. H. the Maharaja of Rajpipla.	The Rajpipla Challenge Cup for the best animal of Rath breed	Kirori Mal, Behror, Alwar .	100

*With miniature

BREED CHAMPIONSHIP CUPS—*contd.*

Donor	Cup and Event	Winner	Cash Prize Rs.
H. H. the Maharaja of Datia	The Datia Challenge Cup for the best animal of Red Sindhi breed	Livestock Officer in Sind, Karachi	..
H. H. the Nawab Ruler Bahadur of Bahawalpur	The Bahawalpur Challenge Cup for the best animal of Sahiwal breed*	Ch. Shauq Mohd. Khan, Prop., Allahabad Cattle Farm, Distt. Multan	100
Lt. Col. C. E. Macguckin, Inspector, Military Dairy Farms, Lahore Cantt	The Macguckin Challenge Cup for the best animal of Murrah breed	Dina S/o Mehdi Hussain, Kalanaur (Rohtak)	100
The District Board, Montgomery	The Montgomery Distt. Board Challenge Cup for the best animal of Nili breed	S. B. Sir Datar Singh, Prop., Montgomery Dairy Farm, Montgomery	100
Mr Abdul Munim, Rais-i-Azam, Member, Distt. Board, Batala	The Walker Munim Challenge Cup for the best animal of Ravi breed	Gian Chand S/o Mohan Lall, Distt. Amritsar	100

CHAMPIONSHIP

Donor	Cup and Event	Winner	Cash Prize Rs.
H. H. the Maharaja of Dhar	The Dhar Challenge Cup for the best draught type bull	Younus Hussain of Bhopal	125
H. H. The Maharaja of Ratlam	The Ratlam Challenge Cup for the best draught type cow	Asghar Khan S/o Akbar Khan of Robal, Rawalpindi	125
H. H. The Maharaja Dhiraj of Patiala	The Patiala Challenge Cup for the best milch type bull	K. S. Dost Mohd. Khan, Prop., Cattle Farm, Jahangirabad, Distt. Multan	125
H. H. The Maharaja Dhiraj of Patiala	The Patiala Challenge Cup for the best milch type cow	Military Dairy Farm, Ferozepore	..
L. Ladli Pershad, Rais, Delhi	The Radha Mohan Memorial Challenge Cup for the best milch type cow (open to private breeders only)	Sir H. C. Dinshaw, Bangalore	125
H. H. The Maharaja of Bharatpur	The Bharatpur Challenge Cup for the best general utility bull	Hanmanth Rao, Hyderabad	125
L. Shankar Lall, Millowner, Delhi	The Madan Mohan Lall Challenge Cup for the best general utility cow	Qazi Shaikh Mohd. S/o Umar Vada of Dajal	125

SUPREME CHAMPIONSHIP CUPS

Donor	Cup and Event	Winner	Cash Prize Rs.
The District Board, Jhelum, Punjab	The Saidullah Khan Challenge Cup for the best buffalo bull in the Show	Mir Allah Bachayo Khan, Jhudo (Sind)	150
H. H. The Maharaja Gaekwar of Baroda	The Baroda Challenge Cup for the best buffalo cow in the Show	Nadhan Singh Rais S/o Ram, Teh. Fazilka	150
H. H. The Nizam of Hyderabad	The Hyderabad Challenge Cup for the best bull in the Show	K. S. Dost Mohd. Khan, Prop., Cattle Farm, Jahangirabad, Distt. Multan	150
H. H. The Maharaja Scindia of Gwalior	The Scindia Challenge Cup for the best cow in the Show	Military Dairy Farm, Ferozepore	..
H. E. The Viceroy and Governor General of India	The Marquess of Linlithgow Challenge Cup for the best animal in the Show	Military Dairy Farm, Ferozepore	..

OTHER SPECIAL PRIZES

Donor	Cup and Event	Winner	Cash Prize Rs.
The Punjab Co-operative Cattle Breeding Society, Amritsar	The Punjab Co-operative Cattle Breeding Society Cup for the best cow bred by Co-operative Cattle Breeding Societies in the area covered by the Northern Region	Qazi Shaikh Mohd. S/o Umar Vada of Dajal	..

*With miniature

MILKING COMPETITION

Donor	Cup and Event	Winner	Cash prize Rs.
Sir Datar Singh, Montgomery Dairy Farm, Montgomery	The Sir Datar Singh Challenge Cup for the highest-milk-yielding cow	Military Dairy Farm, Ferozepore	..
Mr Nusserwanji, H. C. Dinshaw, Bombay	The Sir Hormasji Cawasji Dinshaw Challenge Cup for the highest-milk-yielding buffalo cow	R. S. Ch. Mahla Singh, Bahadur Nagar Buffalo Farm, P. O. Youngpur	50
Mr Zal R. Kothavalla, Director of Dairy Research, New Delhi	The Zal R. Kothavalla Challenge Shield for the highest-milk-yielding animal in the Show	Military Dairy Farm, Ferozepore	..
Mr J. R. Patel, Cattle Dealer, Karachi (Sind)	The Jahangir Patel Challenge Cup for the highest-milk-yielding Red Sindhi cow	Hosur Cattle Farm, Hosur	..

STUDENTS' JUDGING CONTEST

Donor	Cup and Event	Winner	Cash prize Rs.
Messrs Polson, Limited, Bombay	Shield presented by Messrs Polson, Limited, Bombay, for the best team in the Students' Judging Contest	Allahabad Agricultural Institute, Allahabad	75

BULLOCK CART COMPETITION

Donor	Cup and Event	Winner	Cash prize Rs.
The Indian Roads Congress, New Delhi	A pneumatic-tyred bullock cart for the best pair of bullocks	Surja, Bharatpur	Bullock cart

SHEEP AND GOATS

1ST, 2ND & 3RD PRIZE-WINNERS

Breed and Class	Owner	Prize Rs.
Balkhi (young ram)	Ch. Fazal Qadir, Peshawar	15
Balkhi (pen of 3 ewes)	Amir Khan of Kala (Peshawar)	25
Balkhi (pen of 3 ewes)	Amir Khan of Kala (Peshawar)	25
Bikanir ram	Nando Sweeper, Village Bahu Akbar Pur (Rohtak)	15
	Chotu S/o Nathu, Village Bahu Akber Pur, Rohtak	10
Bikaner young ram	Ramji Lal, Breeder of Rana Talwandi, Hissar	15
Bikaner (pen of 3 ewes)	Sheo Karan, Village Bahu Akber Pur (Rohtak)	25
Bikaner (pen of 3 ewes)	Abdul Majid S/o Ch. Niamat-Ullah, Sohna, Distt. Gurgaon	25
	Chotu S/o Nathu, Bahu Akbar Pur (Rohtak)	15
Hashtnagri (ram)	Ghulam Mahboob Khan of Khaishki, Peshawar	15
Hashtnagri (young ram)	Ghulam Mahboob Khan of Khaishki, Peshawar	15
Hashtnagri (pen of 3 ewes)	Ghulam Mahboob Khan of Khaishki, Peshawar	25
Hashtnagri (pen of 3 ewes)	Ghulam Mahboob khan of Khaishki, Peshawar	25
Lohi (ram)	K. S. Dost Mohd. Khan, Prop., Cattle Farm, Jahangirabad	15
	K. S. Dost Mohd. Khan, Prop., Cattle Farm, Jahangirabad	10
Lohi (young ram)	Chiragh, Chak 6-G, Bhawalpur	15
Lohi (pen of 3 ewes)	K. B. Fateh Din, Lyallpur	25
Lohi (pen of 3 ewes)	Chiragh, Chak 6-G, Bahawalpur	25
Barbari (buck)	Abdul Hadi Shah of Sitpur	15
Barbari (young buck)	Abdul Hadi Shah of Sitpur, Distt. Muzaffargarh	15
Barbari (pen of 3 nanny goats)	Jinwada Khan of Sabaiwala, Distt. Muzaffargarh	25
	Qadir Bux of Alipore, Distt. Muzaffargarh.	15
Daira Deen Panah (buck)	Ramzan S/o Sharu-Pauli of Kotadu	15
Daira Deen Panah (pen of 3 nanny goats)	Ghulam Hassan S/o Allah Bux Chanee of Daira-Din-Panah	25
Jamnapari (buck)	Dewan Ahir, Village Carbia, Distt. Etawah	15
	Chakar Pan Ahir, Village Barechha, Distt. Etawah	10
Jamnapari (young buck)	Pt. Anand Madhu, Zemindar, Village Dalipnagar	15
Jamnapari (pen of 3 nanny goats)	Pt. Gopi Nath, Distt. Etawah	25
	Bhopu, Punaia, Pahari	15
Sirli (buck)	Wazir Mohd. Chishti, Peshawar	15
Sirli (young buck)	Wazir Mohd. Chishti, Peshawar	15
Sirli (pen of 3 nanny goats)	Wazir Mohd. Chishti, Peshawar	25

BALUCHISTAN

By Nazeer Ahmad Janjua, M.Sc. (Hons.)
Entomologist, Department of Agriculture, Baluchistan

Among the varieties of grapes imported from the United States of America, it has been found that in addition to Muscats (Muscat of Alexandria, Flame Muscat and Black Muscat), Emperor, a late variety, is very promising as it stands transport well and is therefore suitable for export. Incidentally, it may be mentioned that this is the variety exported from California and sold in the Calcutta market. This variety will be propagated on a large scale during the coming season.

Of the numerous varieties of deciduous fruit, the following have been definitely selected and a large number of them will be available for sale this season :

Apples : French Pink, Gravenstein, Green Stewing, Golden-Delicious, Kandhari, Kulu, Red Astrachan and Ziarat Pippin.

Apricots : Large Red, Luizet and Pavoit.

Grapes : Askari, Haita, Saibi, Shandokhani, Sheikh Ali, Spin Lal, Spin Kishmish and Tor.

Nectarines : Stanwick and Shaleel Early.

Peaches : Acheson Late, Babcock, Elberta, Gaume, Lukens-Honey, Sims and Shahpasand.

Pears : Fertility and Beurre Giffard.

Plums : Alubukhara, Alucha, Victoria and Yellow Drop.

Highest tomato yield

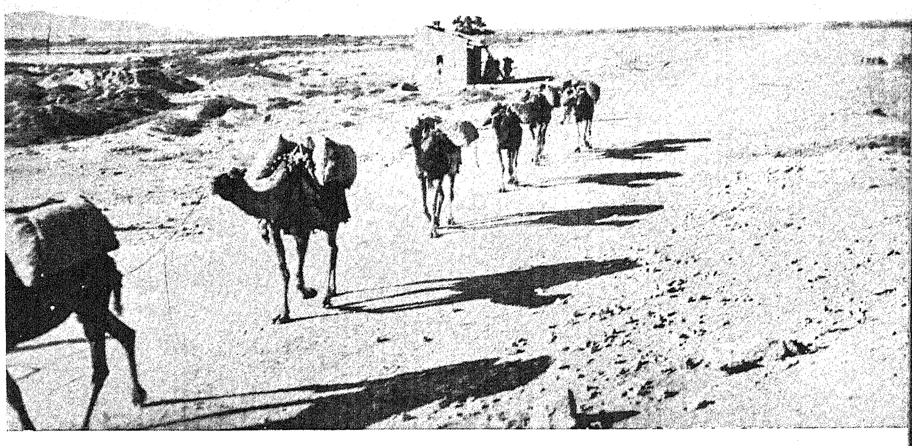
Experiments on the canning of tomatoes under local conditions have given very encouraging results. About 7,000 cans of tomatoes were prepared and supplied to the Defence Forces. Howard recorded a yield of 25 tons of tomatoes per acre at Quetta, while recent experiments have shown that an average of 15 tons per acre may be expected. It is considered that this yield is perhaps the highest in the world so far recorded. Experiments conducted at the Fruit Products Laboratory, Quetta, have shown that an average of 10,000 cans may be expected from an acre under tomatoes. There appear to be, therefore, great possibilities of developing this side of the work. Small-scale experiments have also shown that vegetables like cabbage, cauliflower, turnip, produced in great abundance round about Quetta during the summer months, can be successfully dried. Apart from canned tomatoes, the Fruit Products Laboratory turned out this season nearly 9,000 cans of apricots (white and yellow) and Alucha plums. In quality and pack the canned fruit is at per with the imported ones. These are available at 14 as. per can. Arrangements are being made to dispose of this quantity at wholesale rates. Tomato juice, pomegranate juice, peach squash and pomegranate syrup of very good quality have also been manufactured.

Seed potatoes

The harvesting of the six-monthly crop of potatoes, sown last April in the Ziarat valley, started in September and continued up to the beginning of October. The produce has been marketed under the supervision of the Department, and about 15,000 md. have been sent to markets in Sind as well as Quetta proper. The question of the supply of seed potatoes is becoming acute. Until recently the Italian White Round variety was being grown, but this is not now available. The seed of this variety grown in Sind was procured but gave poor results this season. The Lahori and the Kangra Local varieties have done well and it is hoped to secure large quantities of these for the next sowing.

The egg produce of the province is not sufficient to meet the local demand. Large numbers of eggs are imported by dealers from the Punjab and the N.-W. F. P. The local produce is graded, and during the last quarter of 1941, about 60,000 eggs were successfully marketed at Quetta under the supervision of the Department.

LOCUSTS IN BALUCHISTAN

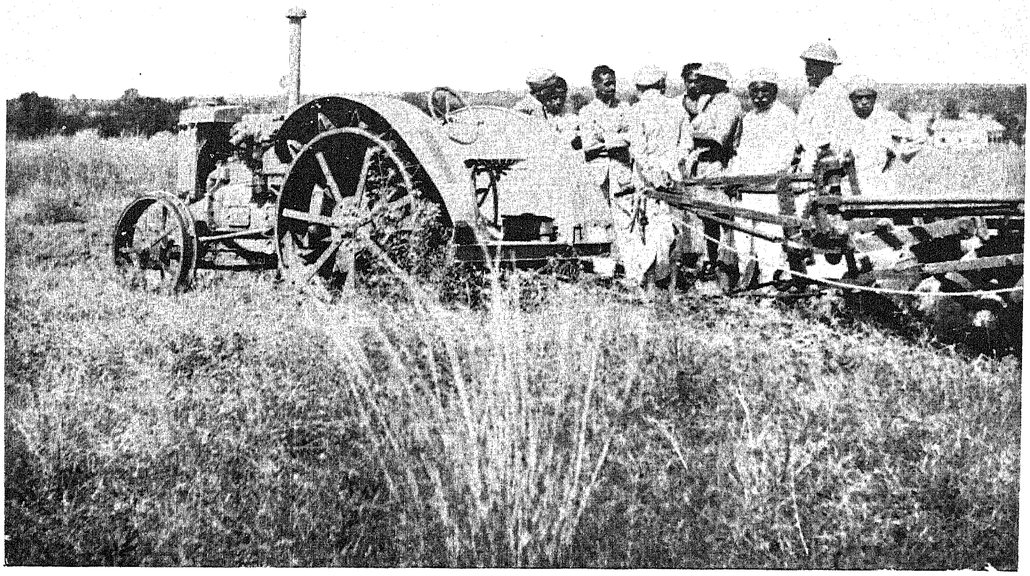


Right :
Camel loads of locusts being brought to Duki (Loralai district)

Left :
Locusts being unloaded

PLATE 58

Right :
A heap of locusts purchased during the day



Members of the Agricultural and Experimental Union interested in the tractor working on the Hebbal Farm.

PLATE 59

The processes of clean jaggery making being explained to the members.

Export of wool

Sheep-breeding is one of the principal occupations of Baluchistan as pasturage is unlimited and the hillsides and valleys are covered with grass and other succulent plants. On this industry largely depends the prosperity of the province. The wool of Bibrick, Khurasani, Taraki and Khetrani breeds, so very common in the province, is considered to be of high quality. The wool from Baluchistan was exported mainly to Liverpool, but owing to war, this market was closed, and as there was an embargo on American markets, it could not be exported to that country either. As a result, wool from Baluchistan was smuggled into Afghanistan from where it was exported labelled as Afghan wool. The local Government, however, approached the Government of India for permission to export Baluchistan wool to America, and the necessary quota of 1,000 bales (approximately 4,000 md.) was granted. This was distributed among the local dealers and thus the export of wool has restarted.

MYSORE

By M. Vasudevamurthy, B.Ag.
Secretary, Mysore Agricultural and Experimental Union, Bangalore

IMPROVEMENT of paddy and cotton, manuring of crops, the working of the agricultural colonies, sugarcane-breeding and a popular account of statistical analysis were among the subjects tabled for discussion at the 22nd annual general meeting of the Mysore Agricultural and Experimental Union and these in general indicate the important lines of work now before the Department of Agriculture. We have just had a round of exhibitions presenting the salient features of agricultural development and the season of cattle shows is following.

The average yield of paddy per acre in Mysore has ranged between 4·1 *pallas** from 1926-27 to 1938-39. Naturally the average has to be lifted higher by increasing the yield wherever facilities exist. The Senior Assistant Botanist in charge of paddy draws attention to the fact that on the Paddy Breeding Station, Nagenhally, near Mysore, the yield per acre which was 11·87 *pallas* in 1929-30 gradually rose to 15·31 *pallas* in 1940-41, owing chiefly to the use of improved strains. Enhancement of yield by application of manures has also been obtained. As an effect of manures, the average yield per acre increased from 878 seers in 1924-25 to 1,557 seers in 1930-31.

It has been shown that two crops of paddy may be taken on the same land during a year, one crop in the rainy season between June and December and another in the summer season between January and June, wherever water is available. In a recent test, on a plot of $2\frac{1}{4}$ acres in the Bangalore district under tank irrigation, an aggregate yield of 9,272 seers of grain was obtained, which works out to 4,120 seers per acre (taking both crops together).

Sugarcane

Recent breeding work has yielded a few more promising strains of cane in addition to the old popular canes, outstanding among which are HM661, HM647 and HM645. Vigorous habit, free tillering, richness in respect of sucrose, drought resistance, suitability for both sugar-making and production of good hard jaggery and a yield of more than 40 tons per acre have all been recorded with regard to HM661. HM647 is described as a vigorous, non-lodging, thick cane with long internodes, also yielding more than 40 tons per acre and well suited for making jaggery. HM645, a thick to medium cane, is described as tillering profusely, yielding more than 30 tons of cane per acre: it is suitable for areas

* A *palla* = 100 seers = 180 lb.

where *cheni* or reed cane is usually grown, yielding excellent quality of white *boora* sugar and an attractive golden-yellow jaggery.

Products of sugarcane

The Chemical Section of the Agricultural Department is devoting considerable attention to preparing good quality jaggery and sugar by the open-pan system. The processes are being popularized and arrangements are being made to supply to the ryots certain accessories that may be required in adopting these.

In the first instance, proper liming of cane juice has been advocated with a view to preparing ordinary jaggery of uniform good quality. This in itself is a considerable improvement over the black jaggery usually prepared in the countryside.

The preparation of special jaggery and *boora* sugar takes one a little further. The sugarcane juice is first limed to neutrality and boiled. After removing the scum, activated carbon prepared by the Department is stirred into the juice which is boiled for about half an hour. The carbon is allowed to settle and the clear juice is let into the striking pan where it is boiled further. By repeated additions of diluted milk all the carbon particles may be removed. The juice is then boiled in the usual manner and may then be converted into clean jaggery or *boora* sugar by rubbing in a pan.

As a further advance in this direction crystal sugar making as a cottage industry is receiving attention. The complete plant for this consists of one sugarcane mill, three circular pans for juice boiling, four crystallizers of special design and a centrifugal machine. The quality of sugar obtained now and recovery of sugar on cane is considered to be encouraging.

Cotton in red soils

The Botanical Section of the Agricultural Department is testing several varieties of cotton for the red soils in both irrigated and dry tracts. Among these are varieties locally evolved as well as introduced. The two strains that are now grown on a large scale are MA II and Co4. MA II evolved by the Mysore Department of Agriculture grows well on all soils. It is a medium staple cotton with $\frac{3}{4}$ in. staple and 30 per cent ginning and spinning up to 30's. It yields 800-900 lb. per acre under irrigation and even in dry land yields up to 25 maunds* have been recorded. It is reported that this variety is rapidly replacing *Doddahatti* varieties grown commonly in the Banavar area of Hassan district. Co4, one of the important cottons evolved by the Department of Agriculture, Madras, has been found to grow well under irrigation, yielding about 1,000-1,200 lb. per acre. A specification of $1\frac{1}{8}$ in. staple, 34·5 ginning percentage and capacity to spin up to 40's has been reported. This variety has played an important part in the extension of cotton in the Irwin Canal tract.

It is as an alternative to sugarcane that cotton has developed in the Irwin Canal area. There is a chance for its competing with paddy also under certain conditions of soil and irrigation. In other tracts it faces such crops as *jola*, groundnut and *ragi*. Cotton growing in red soils has been practised, but its extension as an inter-crop of *ragi* has been fairly successful.

Cattle-breeding stations

The Report of the Fodder and Grazing Committee in Mysore mentions straw from cultivated fodders as the mainstay of the cattle, there being a total of 3,690,790 acres under all cereals and inter-crops in the state. On average it will be seen that *ragi* meets nearly two-thirds the estimated produce from this source.

Cattle-breeding stations occupy an important place in the improvement of Mysore cattle. The chief aim of a station is stated to be the production of domesticated stud bulls and draught animals which combine efficiency, hardiness, good breeding qualities and at the same time are capable of being handled easily. One or two stations have already been mentioned in the earlier reports. In addition to the cattle-breeding station at Ajjampur, Kadur district, and that at Hunsur in the Mysore district, others have been instituted at Devapura near Hosadurga for the Chitaldrug district, at Garudapalya

* Mysore maund = 28 lb.

in Malur taluka for the Kolar district, and at Lakkihalli for the Tumkur district.

Control of epidemics

Alongside the general improvement of the local cattle, the equally important aspect of protecting them against epidemics and diseases is attended to. The Mysore Serum Institute has played an important part in this regard for the last decade and more. The yearly mortality of cattle from rinderpest has been considerably reduced as a result of the work of the institution. In 1925-26, 34,228 animals died of this disease. Since then the closing years of the two decades compare as follows:

Year	Mortality	Year	Mortality
1926-27	12,321	1936-37	1,078
1927-28	14,891	1937-38	1,680
1928-29	28,041	1938-39	2,520
1929-30	8,950	1939-40	1,756

The Institute has supplied a total quantity of over fifteen and a half million unit doses of different biologicals up to the end of June 1941.

Sheep improvement

Next to cattle, sheep claim a place in the chronicle of development. They come before us—especially in the exhibition season—by contributing certain articles that go round the exhibitions, the woollen fabrics. Charts are studied, samples are seen and processes are observed, but certain things must be bought by the visitor. Of this last class must be mentioned clean jaggery, Mysore honey and woollen manufactures. Behind the attractive carpet or the shawl is the attempt at sheep improvement in Mysore and the formation of sheep-breeding associations. With a view to improving the quality and quantity of wool and helping the sheep and wool industry, the Department of Agriculture is maintaining at present four sheep-breeding farms at Hebbal, Yellachihalli, Hunsur and Garudapalya, and a sheep-breeding scheme subsidized by the Imperial Council of Agricultural Research is in progress. There are now five sheep-breeders' associations with centres at Kolar, Bangalore, Mysore, Closepet and Channarayapatna and as reported by the Sheep Expert, two more associations are to be started early, one for the Mandya district and another for the Tumkur district. The objects of the associations in general are: (1) expanding sheep husbandry by popularizing superior breeds, gradually replacing black sheep by white ones, and helping the members to establish good foundation flocks; (2) providing and creating facilities for shearing, dipping and veterinary aid; (3) creating marketing facilities for wool and stock, and to this end (4) moving the Government for executive or legislative action and assisting the Agricultural Department to conduct experiments conducive to the improvement and prosperity of sheep husbandry.

HYDERABAD

By Kalidas Sawhney, M.Sc.

Director of Agricultural Research, H. E. H. the Nizam's Government, Hyderabad

THE Department of Agriculture, Hyderabad State, has during the past few years been engaged not only in the improvement of existing crops but has also made attempts to introduce new crops or extend the cultivation of old crops in new areas. The following paragraphs give a brief account of the work done in this connection.

Groundnut has been in cultivation in the south-western part of the state for many years. It has now been extended to the south-eastern districts as also to a greater part of the north-western zone. The area brought under this crop in these new regions totals over 2 lakhs of acres. The entry of this crop in the rotation previously in vogue has converted a two years' rotation into one of three years.

With the provision of canal irrigation facilities in Nizamabad district, the growing of improved varieties of sugarcane from

Coimbatore has been introduced in this tract. The new varieties now cover an area of over 11,000 acres. A well-equipped factory for the manufacture of sugar has also been established so that the growing of sugarcane in Nizamabad district has come to stay.

As a result of careful experiments conducted by the Agricultural Department for several years, the tobacco variety, Harrison Special, is being recommended to the cultivators of Warangal and Parbhani districts. The area under this variety in the current season 1941-42 exceeds 2,000 acres in the former and 300 acres in the latter district. The cultivation of the crop in the rain-fed areas has become quite popular and the acreage is expected to increase rapidly.

The cultivation of high-quality cigarette tobacco has also been attempted as a lightly irrigated crop in the Nizamabad district. The indications obtained so far are very encouraging and nearly 30 acres are under this variety in the present season.

The growing of wheat as an irrigated crop in certain parts of Nizamabad district has been taken up very recently. The prospects of the extension of area under this new crop seem promising.

The cultivation of cotton at present is confined largely to the black-soil tracts of the state. Very little cotton is grown on granitic soil in the Telingana Division. The cultivators of this area grow chiefly *jowar* (*sorghum*) and castor as dry crops. In order to provide an alternative cash crop, experiments were conducted with cotton for several years. The results of these experiments show that an improved variety of Gaorani cotton (Gaorani 12) can be grown successfully on deep *chalka* (granitic) soils. The cultivation of this variety of cotton now forms part of the work of the Department of Agricultural Propaganda. Many cultivators are taking up the growing of cotton and have to that extent diversified their farming.

Grape fruit and pineapple have been introduced as new fruits. The area under them is gradually expanding.

PUSHKAR LIVESTOCK FAIR

By M. R. Mahajan, M.R.C.V.S.
Animal Husbandry Officer, Ajmer-Merwara

SEVEN miles from Ajmer and separated by a serpentine hill stands Pushkar, famous for its sacred lake. It is one of India's sacred places and here alone is to be found Brahma's temple. Pushkar is held to be the king among shrines by Hindus all over this land. Thousands of pilgrims bathe in the sacred waters of the Pushkar Lake on the full-moon day in *Kartik* (November) every year, when legend says Brahma performed the *Yagna*. Taking advantage of the vast gathering of people on this occasion an animal market and show for livestock is held on the occasion. The District Board, Ajmer-Merwara, manages and runs the fair and is benefited by the levy of a capitation sale tax ranging from 4 as. to Rs. 10. Being centrally situated, Pushkar naturally attracts dealers from all over Rajputana, the Punjab and the United Provinces.

Scale of the show

The fair which was held from 30 October to 4 November in 1941 attracted an entry of 25,000 animals and of these 13,134 were cattle, 10,107 camels and 1,759 horses. Of this number about 50 per cent changed hands and the amount involved was Rs. 7,72,029.

Cattle sold at the fair came mostly from Jodhpur (Marwar), Ajmer, the United Provinces, Jaipur and the Punjab. They were almost all bullocks. The Nagori breed predominated. Sanchori (Kankrej) also came in good numbers. In small numbers the Gir and the local (non-descript) type were also present. The prices of cattle ranged from

Rs. 4 to Rs. 250, with an average of Rs. 54. They were purchased and taken to Jaipur, the United Provinces, Ajmer, Jodhpur, the Punjab and to other small Rajputana States.

Camels were in great demand. They came mostly from the Punjab, Jaipur, Jodhpur, the United Provinces, Ajmer, Udaipur and Haroti. Both riding and baggage type were represented. Prices ranged from Rs. 6 to Rs. 240, with an average of Rs. 72. On purchase they were taken to Jodhpur, Udaipur, Ajmer, Jaipur and other states of Rajputana.

Horses came in small numbers as compared to cattle and camels. They came from Jodhpur, Udaipur, Jaipur and from breeding centres in the Punjab. Both thoroughbred and indigenous breeds of Marwari and Kathiawari were assembled. Ajmer-Merwara was well represented by the Istimrardaıs of Bhinai and Kharwa. Prices of horses ranged from Rs. 5 to Rs. 900 with an average of Rs. 98. On purchase they were taken to Jodhpur, Udaipur, Jaipur, Indore and Kathiawar.

Judging by breed

Animals worthy of competing in the show were collected and judged in the rings in about 40 different classes according to breed and age. A total of 313 animals competed in the show in 1941 and cash prizes to the extent of nearly Rs. 1,000 were awarded together with valuable cups, medals and *sanads*. This year the cattle were classified and judged according to breed and new classes were introduced to encourage milch animals.

In addition to a well-equipped veterinary dispensary the Animal Husbandry Department organized a propaganda stall along with other development departments. A co-operative rally was a feature of the show. All departments took advantage of educating cultivators in the Cooperative Assembly organized under the chairmanship of Mr Damle, I.C.S. A film of the show was taken by Indian Educational Pictures for propaganda purposes.

Sports were held and prizes given away by Mr G. A. Faruqi, I.C.S. on the full-moon day when the attendance was at its peak.

The Month's Clip

SOME NOTES ON CAPRICULTURE

Or Pigs Is Pigs, but Goats Are Different

By Lera Knox

DR HARVELL looked down at the pale starving baby and scratched his head thoughtfully, 'If we had an old goat...' he said.

'What do you mean, Doctor?' the baby's father asked eagerly.

'I was going to say, if we had a goat, we'd try that. We've tried about every baby-food we know, and none of them seems to help her. Sometimes a weak stomach can retain and digest goat's milk when it can take nothing else.'

'Well, Doc,' replied the anxious parent, 'I don't know whether there is a goat in this county or in a neighbouring county, but if you think goat's milk will help that baby, I'll get you a goat.'

It so happened that old Uncle Nelse Pope, over at Pearly Hill, was reputed to have a goat and a kid, so J. W. Howard of Carter's Creek made haste to Pearly Hill.

Uncle Nelse didn't choose to sell Mme. Nanny. 'A man might as well sell his houn' dawg, his banjo, or his bedstead as to sell his goat,' he reasoned. But the distressed father was a good trader. He bought the kid (so it could be removed from competition) and rented the doe for a dollar down and a dollar a month.

By noon that day, the delicate little Howard baby took a half-teacupful of goat's milk. Mother, father, doctor, and relatives anxiously awaited results. According to the custom, the milk would be vomited within twenty to thirty minutes, vomited in thick curds. But custom didn't rule. Instead of the milk coming up, the baby brightened up. 'She was like a wilted flower freshening after a rain,' her parents said. Then she went to sleep, and the family went out to feed Nurse Nanny.

That night the baby took another half cup of milk (all the goat had) with the same success. Early next morning Mr Howard set out in search of another goat. One wouldn't be enough to make that poor, thin baby into the plump, rosy-cheeked daughter her parents wanted her to be.

Over at Dark's Mill he found a man who owned twelve goats. One was fresh in milk, and from her looks she would give enough milk to supplement that of the rented Mme. Nanny. But her owner wouldn't sell her. Folks are funny that way about their goats, if they won't sell, they just won't sell. That's all. This owner wouldn't sell one goat, but he would sell the whole herd. So Mr Howard took twelve goats.

They were the 'wildest of the wild,' he said. They were not designed for milking, nor accustomed to it. But he stalked them out in the grass lot across from Wash Russell's, and went out every four hours to wrestle with that selfish and frightened old doe for a bottle of milk for baby.

Meanwhile the baby waxed strong, and yelled lustily for more milk and yet more milk. Daddy went a-hunting again, and brought in another herd of goats. When they went dry he bought another herd. And so on, until his hills were pasturing a hundred or more goats.

'Not that I minded,' he said, 'The baby was growing, and the goats were actually making me money. I don't believe I ever lost a nickel in buying or renting goats.'

By the time the second baby came, two years after Nina Joe began to fatten and grow on the milk from Mother Nanny, the Howards had learned that goats are not just goats—some are milk goats. From down on Lieper's Creek came two half-breed Toggenburg does. They were as far ahead of the common old

brush goats as a good grade Jersey is ahead of a long-horned range cow.

Herd also boasts Saanens

As the girls grew into robust, rollicking, pony-riding youngsters now 11 and 9 years old, the goat herd decreased in number but increased in quality. It boasts now of not only good Toggenburgs, but also some aristocratic registered Saanens.

Pigs is pigs, perhaps, but goats *are* different, especially milk goats. They are Alpines, Nubians, Saanens and Toggenburgs. Those are only the breed names. Names of individual goats, those registered by the American Milk Goat Association, sound like a string of pullman cars, for instance these are some of them: Happy Lady, Agawamas King, Saxtet's Fluffle, Rastus Pingle, Wedgewood Calico, Supreme-in Every-Way, Countess Esperanza, Quapaw Violet, Rosario, Tazetta, Alto Redbud, Columbine Americus, Emily Ann, Gaiety Girl, Red Cloud's Yobo, Princess Juanita, Caddo Samona, Just Patsy, Damito, May's Daisy, Chewinkle, Ireta, Blossom Jason, Fledi, Benz Franz Andreas Hofer, Joybell, Jaure, Fandango, and Bill Malcolm—those are among the blue bloods of milk goatdom.

There is this difference in milking a goat and milking a cow. In milking a cow, the man has the stool and the cow beside him; in milking a goat, the goat has the stool and the man stands beside her.

Goat's tail does not interfere

One thing about a goat is commendable; She never switches her tail across the milker's face. Her tail is not long enough.

There is a difference in goat's milk and cow's milk, they say. Goat's milk has smaller globules of fat, and on this account is more easily digested by weak stomachs. Taken into the stomach, it becomes alkaline instead of acid, this also is in favour of its digestion. It is rich in minerals, salts, proteins—and everything that milk ought to have—say its 'fans', and it is almost sure to be free from TB germs, for goats don't take TB.

Pat, the Irishman, explained this by saying: 'Shure and it's the smell that protects the goat from TB. The germs smell the goat acoming and then they just curl up and die.'

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But goat raisers declare there need be no bad odour to milk goats or to goats' milk if the animals and their houses are kept clean. Milk goats are exceptionally clean in their habits and contrary to the general opinion, they do not demand a diet of ashcans, tin pans, and stewed sewer pipes. They eat practically the same food as that chosen by a good cow, but about one-sixth as much. And the up-to-date goat keeper would no more think of feeding garbage to his milk goats than an up-to-date hostess would serve hot dogs at a bridge luncheon. If you could read over the menu of one of the fine dairy herds of goats in Nashville, Memphis, Indianapolis Chicago, or Denver, perhaps you would decide that being a milk goat is somewhat better than just being a goat. Goat's milk is said to sell for three or four times the price of cows' milk. But sick folks and parents of sickly babies think it's worth the extra price.

Milk source came to door

It used to be an old Parisian custom to drive a herd of goats along the streets with musical accompaniment. When the householders heard the fife they would snatch up their milk bottles and run out to meet their source of supply. That, perhaps, was the first direct-from-producer-to consumer business.

Goats give from two quarts to six quarts, or more, of milk a day. A 'gallon doe' is about as rare as a four-gallon cow. But some goats give more than nine quarts a day on test. Needless to say, they are valuable. Some sell for as high as $1,000. One has been known to have sold for $15,000—now wouldn't that get your goat?

Look into the face of some dear old nanny. If she could talk she might tell you that although her ancestors, the Capra family, might not have been listed on the Mayflower, they have been here a long time. They may have come over with Columbus. In the Old World they are almost as ancient as Eden. They have been patient, loving, and long-suffering servants to man throughout the centuries.

Egyptians worshipped goats, Hebrews sacrificed them: Mendesians mourned for them; Pharaohs carved their faces on the pyramids; priests piled sins upon them and

drove them into the wilderness; astrologers set them in the heavens; pickaninnies have hauled stovewood with them, and lodge brethren are reported to have ridden them.

Skin still used for clothing

The well-dressed young man of ancient times wore goat skins around his loins. The well-dressed young woman of today wears kidskin around her toes and fingers. Temple walls and aged women have been draped with goat's hair. In temples, we call such hangings curtains; on the women we call them cashmere shawls—but the goat is the producer of them all.

Goat skins also make our finest book bindings. Of course, book agents call such bindings 'Morocco', but that is just a fancy name for goat-hide.

The beauty of Nero's wife, and the stamina and vigour of Mahatma Gandhi are attributed to goat's milk. She took it externally, by way of the bath. He takes it internally, when not on a fast.

We owe even our morning coffee to William the Bleater, or some other aristocrat of goatdom, says a hint in the *Goat World*, a magazine I must thank for many of these goatly tips. Once upon a time the Arabians made a practice of tying their goats to coffee trees. They noticed that the brave old billies who ventured to chew the coffee berries were more capricious (or probably the word should be caperish) than those that couldn't reach the berries.

From observing the billies, the Arabians began to try a few coffee berries in their soup. They've been at it ever since, and we have taken up the habit—all because of some venturesome old billy goats.—*The Goat World*, Vol. XXVI, No. 5, May 1941.

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MOSQUITOES AT PICNICS

MANY a summer outing or a pleasant week-end afternoon in the garden is spoiled by mosquitoes. While not ensuring complete control, measures may be taken to give at least some protection for short periods in limited areas. A spray for this purpose is mentioned by C. R. Twinn, Division of Entomology, Dominion Department of Agriculture, in publication No. 719 on 'Mosquito Control in Canada'. The spray may be prepared by thoroughly emulsifying one gallon of kerosene containing the extract of one pound of pyrethrum powder (a standard pyrethrum fly spray would do) with one-half gallon of water in which four ounces of liquid soap (40 per cent) have been dissolved. This concentrated emulsion, after being well shaken until thoroughly mixed should be diluted with 10 parts of water and sprayed as a fine mist on lawns, shrubs, and other vegetation, by means of a pressure sprayer with a suitable nozzle, using about 55 gallons of spray per acre. The application should be made about half an hour before the picnic or the meeting takes place. This spray may also be substituted for petroleum oil in treating ponds and other water bodies to kill mosquito larvae and pupae, using about 50 gallons to the acre of water surface.

However, in mosquito control, although individuals on their own property may assist greatly by preventing mosquitoes from breeding, best results are obtained only when the work of control is organized on a community scale, either by public-spirited citizens or by municipal or other authorities, and is carried out under competent direction and with adequate funds.

The publication 'Mosquito Control in Canada' gives full information on the subject, together with other measures of permanent and temporary character, the life-history of mosquitoes, and protection from bites. By writing to Publicity and Extension Division, Dominion Department of Agriculture, Ottawa, a free copy may be obtained.—*Press Note, Dominion Department of Agriculture, Canada.*

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DAIRY UTENSILS

IT is necessary to know something of the nature and composition of milk and its products in order to understand the reason for the thorough cleaning of dairy utensils.

Milk is a complex substance consisting of water, butterfat, milk sugar, casein, albumen and mineral salts. Cream contains the same constituents in different proportions. The problem of cleaning, therefore, largely resolves itself into the removal of fats, sugar, proteins and salts.

Sugar and mineral salts being mainly in solution are almost entirely washed away by rinsing utensils in cold water. The water will also remove a large proportion of the fats and proteins. Butterfat, however, occurs in the form of minute globules, many of which stick to the surface of dairy utensils so that emulsification is necessary to remove them. Casein is in suspension in fresh milk, but can be coagulated by acid or rennet, or it may form a solid curd, the hardness of which is increased by heating; albumen is in solution but is readily coagulated by heat.

Both casein and albumen possess considerable adhesive properties and will stick firmly to dairy utensils unless the latter are first rinsed in cold water. If cold water is not used first, the casein and albumen will cook hard on to the surface of utensils in subsequent hot-water washing and steam sterilization. Once these substances are cooked on they will form a protective covering or layer under which bacteria will multiply because the sterilizing heat cannot reach them. A layer of fat spread over the surface when utensils are rinsed in hot water also forms a similar protective covering for bacteria. This can be avoided only by rinsing in cold water and washing with sufficient hot water in which a suitable soda compound to free the fat has been dissolved.

Method of washing: When dairy utensils have been used for sweet milk they are comparatively easy to clean, but if the milk has been allowed to dry on the surface or to become sour washing is no longer so simple.

1. *Pre-rinsing in cold water*: Utensils must be well rinsed in cold water as soon as possible after use. This is very important, for once milk has been allowed to dry, it is much more difficult to remove it thoroughly.

On no account should utensils be rinsed in hot water, or in the water used for washing. The milk residues will dilute the cleansing power of the cleaner used and hot water will cook the casein and albumen on to the surfaces of utensils.

2. *Washing*: Use really hot water and dissolve in it sufficient detergent, i.e. washing soda or other suitable washing powder. Do not use cleaners containing any gritty substance, as this will permanently damage surfaces by scratching and will rapidly remove the tin. Use enough soda or other cleanser to emulsify the grease so that no fat globules can be seen floating on the surface of the water (usually $\frac{1}{2}$ lb. soda per 10 gal. of water). Scrub with a stiff brush. If proprietary cleansers are used, follow the manufacturers' directione closely. Weak solutions are ineffective and too highly concentrated solutions are uneconomical and will corrode the utensils.

3. *Rinsing in hot water*: Finally rinse off the soda with fresh hot water.

Sterilization: There is no substitute as effective and economical as boiling water and steam for the sterilization of dairy utensils and there is no substitute for sterilization, but it must be preceded by thorough washing.

Under certain farm conditions, boiling water is still the only means of sterilization available and is effective provided the temperature of the water is 212°F. At best, however, it cannot be as effective as the careful use of steam.

The intelligent application of steam to all utensils should be a routine procedure, and the flushing out of all utensils with scalding water just before using them is strongly advocated. All utensils should be steamed until they are too hot to handle. After removal from the steam wet cans may be laid on their sides for a short time to allow the steam to escape. There should be enough heat left in the metal to evaporate the small amount of water formed through condensation. Utensils must never be wiped to free them of this water caused by condensation.

Small utensils such as quart measures, scrubbing brushes, etc. are best sterilized by placing them in a can and directing steam into the can by means of a steam hose. The opening of the can may be covered with a sack.

Coolers may be sterilized by providing a jacket to cover the cooler while it is being steamed. Spray steaming is useless. If a steam oven is available, it will solve the problem of cooler and small utensils.

After sterilization, utensils should be protected from contamination until needed.—*Press service, Department of Agriculture and Forestry, Pretoria.*

firms the growing opinion of the reader that this is indeed a veritable Mrs Beeton of the gardener, for the generous treatment which the writer would accord to the growing plants is paralleled by a series of delicious-sounding recipes which determine that the gardener shall enjoy to the utmost what he has grown by having his vegetables well cooked and his flowers well arranged.

The book is written for beginners, and indeed beginners can well follow it, but there is a wealth of information which will prove of the greatest value to many who have had years of experience in gardening. It is a book which lives up to its proclaimed purpose of striking an intermediate note between the light and chatty books which make delightful reading and the standard books which contain so much that is indigestible for a beginner. In fact, it is a book which, at a very low price, will meet the requirements of the great majority of amateur gardeners in India, and thus fills a long-felt need.—(G. W. P.)

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The Indian Journal of Genetics & Plant Breeding

(Secretary, India Society of Genetics and Plant Breeding, Imperial Agricultural Research Institute, New Delhi, Vol. I, December 1941, pp. 86, Rs. 8)

THE Indian Journal of Genetics & Plant Breeding is the official publication of the Indian Society of Genetics and Plant Breeding founded in January 1941. The Society was founded to advance the cause of genetics and plant breeding in India and to encourage and promote study and research in these subjects; to disseminate knowledge on genetics and plant breeding and to provide facilities for association and conference among students of heredity and for the encouragement of close relationship between workers in genetics and plant breeding and those in the related sciences. Normally, the journal will be published twice a year but the present issue will be the only number in 1941. The present volume opens with an interesting article by Dr W. Burns, Agricultural Commissioner with the Government of India, on 'Some Ideas and Opportunities for Plant Geneticists in India'. There are a number of useful papers by well-known Indian workers on plant breeding and genetical subjects. Dr B. P. Pal, Imperial Economic Botanist, the enterprising Secretary of the Society, deserves credit for pooling a number of useful papers by well-known Indian plant breeders and getting these out in print in this first volume so soon after the Society was formed. The credit for the faithful reproduction of the plates and the good finish given to the publication goes to the Job Press, Cawnpore.—(S. C. R.)

***

Monthly Bulletin of the Bangalore Dairy Cattle Society

Edited by A. K. Yegnanarayana Aiyar (86-7 Mysore Road, Bangalore City, Annual subscription Rs. 3)

WE welcome the appearance in January of the *Monthly Bulletin of the Bangalore Dairy Cattle Society* which must be the first of its kind published in India. In the popularization of scientific knowledge among dairy breeders this publication will be able to render service of the greatest importance. As the organ of the Society, it will be the chief medium through which 'the Society will try to disseminate information on matters of dairying that may be of use to members and to voice such ideas and representations as may be found necessary or appropriate'.

The first issue has attractive features such as 'Cattle in Health and Disease', 'Milk and Milk Products', 'Feeds and Fodders' and a query column. The style is popular, and the articles, especially the one on milk by the Editor, are extremely competent summaries of current knowledge.

The *Monthly Bulletin*, which is very well produced, has made a good beginning, and we wish it all success.—(F. M. de M.)

Giant trenching plough weighing four tons

PLATE 62

From All Quarters

COIMBATORE SUGARCANES

THE Imperial Sugarcane Breeding Station at Coimbatore frequently receives indents from private plantations, mill estates and others for planting material of seedling or other canes. It is announced for the information of all concerned that the standard practice at the Station has been not to supply such material direct from Coimbatore. Such indents are, therefore, transferred to the Director of Agriculture of the concerned province or state for disposal.

Secondly, indents for bulk supply of certain canes are received from various agencies including Agricultural Officers. Owing to the very large number of varieties and seedlings that have to be grown each year at the Coimbatore Station for testing and distribution, the quantity available of any particular cane is very limited and this limited supply has to cover indents from all over India and from foreign countries as well in normal times. The Coimbatore Station is, therefore, unable to comply with such requests.

***

GIANT PLOUGH

A GIANT trenching plough weighing four tons is now at work in England turning acres of waterlogged ground into land which will yield crops next year.

It is an ingenious trenching implement designed in the North of England chiefly for use in land drainage. The new machine cuts channels to a depth of two feet nine inches at the rate of a hundred yards in four minutes.

The base of the trench is cut by a share, while cutters carve the sides, the earth passing up inclined boards to ground level where it is formed into equal ridges on each side. The implement is hauled by a pair of windlasses, driven by two diesel engines placed at each end of the field. One windlass pulls the implement along when cutting, the other returns it into position for cutting the next trench.

The standard windlass employed for this work by the designers has a range of gears with different speeds for different soils, and the winding drum carries 450 yards of steel plough rope.

The implement can be hauled by the steam cable engines used for ploughing and cultivating, or by the large types of direct tractors.

In the Zuider Zee reclamation, a machine from the same designers cut two million yards of trenches in 20 months.

***

WOODHOUSE MEMORIAL PRIZE

IN memory of Mr E. J. Woodhouse, late Economic Botanist and Principal of Sabour Agricultural College, who was killed in action in France in 1917, a prize in the form of a Silver Medal and books of a combined value of Rs. 100 will be awarded to the writer of the best essay on a subject to be selected from the list noted below. The length of the essay should not exceed 4,000 words.

The competition is open to graduates of Indian Universities and to Diploma holders and Licentiates of recognized Agricultural Colleges in India who are not more than 30 years of age on the date of submission of their essays.

Papers should be forwarded to the Director of Agriculture, Bihar, Patna, before 30 June 1942.

In case papers of sufficient merit are not received, no award will be made. Essays must be typewritten on one side of paper only.

The subjects for the essay are :

1. The importance of sex in heredity.
2. Soil-borne diseases of field crops in the Indo-Gangetic plain.
3. Recent work on the improvement of field crops in India.
4. The contribution of the plant breeder to the agriculture of Bihar.

SEX DETERMINATION

THE mystery of the birth of male and female has been nearly solved in Assam according to Mr J. C. Chakrabartty, P. O. Sapatgram, Dhubri, a reader of INDIAN FARMING.

According to this reader a fairly long list of calves, the progeny of the Government breeding bull No. 91, now under his care, shows that whenever a cow is covered between 7 to 12 a.m. a male will be born; and whenever covered between 12 noon and 6 p.m. a female will be born. In all 28 cases were recorded.

This is an interesting observation and the reader requests that for verification a record may be kept in dairy farms of the date and time of covering and the sex of the offspring.

OBITUARY

WE regret to record the death of Mr R. V. Panikkar, Principal of the Madras Veterinary College, on 7 January 1942. After his early education in Trivandrum and Madura, Mr Panikkar went in 1918 to Great Britain, where he took his degree of B.Sc. (Vety.) and the M.R.C.V.S. diploma. On return to India in 1924 he was appointed Deputy Superintendent in the Civil Veterinary Department in Madras, and later held a teaching post at the Madras Veterinary College. Three years ago he was appointed Principal of the College.

He undertook a course of post-graduate studies at the Imperial Veterinary Research Institute, Mukteswar, last year. At the time of his death he was 45 years of age.

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ISSUED BY
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Vol. III — MAY 1942 — No. 5

AGRICULTURISTS IN CONCLAVE

THE biennial tribal *jirga* of agricultural workers and scientists in India took place when the Crops and Soils Wing of the Board of Agriculture met in New Delhi on February 18th to 21st. The subjects discussed and the leaders of each discussion were as follows :

Subject	Leader of the Discussion
1. A review of the history and results of agricultural education in India.	Mr W. M. Clark, Principal, Agricultural Institute, Dacca, Bengal.
2. A review of (*a*) methods of assessing soil fertility.	Dr J. K. Basu, Soil Physicist, Sugarcane Research Station, Padegaon, Bombay Presidency.
(*b*) the effects on soil fertility of cultural practices other than manuring.	
3. A review of the work done by agricultural engineers in India, with suggestions for the future development of agricultural engineering in this country.	Mr M. Vaugh, Agricultural Engineer, Allahabad Agricultural Institute, Allahabad.
4. A review of the theory and practice of mixed cropping in India.	Rao Bahadur G. N. Rangaswamy Ayyangar, Millets Specialist, Coimbatore, Madras Presidency.
5. A review of our knowledge regarding the degeneration of improved crops in India.	Dr B. P. Pal, Imperial Economic Botanist, Imperial Agricultural Research Institute, New Delhi.
6. Suitable procedures for laying out experiments in the fields of cultivators.	Mr T. G. Rama Iyer, Director of Agriculture, Mysore State, Bangalore.
7. Measures necessary for ensuring trueness to type, high germination capacity, and freedom from disease of agricultural and horticultural seeds sold to the public.	Mr D. R. Sethi, Director of Agriculture, Bihar.
8. A review of Indian legislation on the control of insect pests and fungoid diseases of crop plants.	Dr Khan A. Rahman, Government Entomologist, Punjab Agricultural College, Lyallpur.
9. The effects of climatic factors on plant growth, crop yield and the incidence of pests and diseases.	Dr L. A. Ramdas, Agricultural Meteorologist, Meteorological Office, Poona, Bombay Presidency.
10. New economic crops .	Dr B. P. Pal, Imperial Economic Botanist, Imperial Agricultural Research Institute, New Delhi.

The Wing was opened by the Hon'ble Member for Education, Health and Lands, Mr N. R. Sarker, whose address we give *in extenso* immediately after this editorial.

All the subjects produced good discussions. The first subject (agricultural education) roused such an important debate that a sub-committee was appointed to go further into the matter and draft a resolution, given later in this issue.

As regards agricultural engineering, it was recognized that in the past agricultural engineers had been called upon to perform a great multiplicity of duties. In the future the work of agricultural engineers would be particularly required in connection with agricultural machinery of all kinds, including

bullock-drawn and tractor-drawn implements and water lifts and in connection with all kinds of soil conservation work, including *bunding* of various types.

The discussion on subject 4—Mixed Cropping—evoked a wealth of experience from various members of the Crops and Soils Wing and indicated the need for making a complete list of existing practices and for the experimental testing of the growing of crops pure and mixed in different proportions.

There was also an interesting discussion on subject 10—New Economic Crops. During the discussion a member raised the question of the need for planning and control of food production. This subject received much fuller discussion at the Advisory Board of the Imperial Council of Agricultural Research held in the following week.

In addition to the valuable information contained in the printed notes contributed by authors and in the discussions which will be reported fully in the printed *Proceedings*, the Crops and Soils Wing once more fulfilled its excellent purpose of bringing together agricultural workers who do not otherwise have an opportunity of meeting and who were able, both inside and outside the conference hall, to make valuable contacts and exchange useful experience.

S. K. MITRA

M.Sc., Ph.D., I.A.S.

An Appreciation

IN February this year Dr S. K. Mitra, Director of Agriculture, Assam, retired on reaching the age limit: he had been Director of Agriculture since 1 August 1937.

His university training was received in America where he took the degree of B.Sc. in 1914 and the degree of M. Sc. in the following year. Between 1918 and 1920 he was a Research Fellow at the Ohio State University, Columbus, which conferred on him the degree of Doctor of Philosophy in 1920. In the same year he was appointed Instructor of Science at the Agriculture and Technical College, North Carolina, U.S.A., where he worked till the end of the year. Like so many men who have gone through American universities, he earned by his own exertions much of the funds required for his college career.

He was appointed by the Secretary of State for India to be Economic Botanist to the Government of Assam and joined his duties there on 28 February 1921. He did valuable work in rice-breeding and has given many important varieties of rice to the province. As is well known, rice-breeding is not a simple matter, since varieties have to be selected or evolved from so many different types of paddy and for so many different conditions of paddy growing. The starting of research work on deep-water paddy at Habiganj was the result of his own efforts. The starting of citrus research with its centre at Burnihat is due to him and he also carried out and supervised work on sugarcane. He was interested in fruit preservation and canning and did work on these lines and also produced several publications on fruit-growing and preservation.

His publications both in America and in India form a long list and he has also to his credit four books, viz.

Vidyalaye Udvid Parcharjya (Bengali), published by Krishisampad, Dacca.

Citrus By-products and Utilization of Wastes, published by Krishisampad, Dacca.

Canning and Preserving, published by Messrs Thacker, Spink & Co., Calcutta.

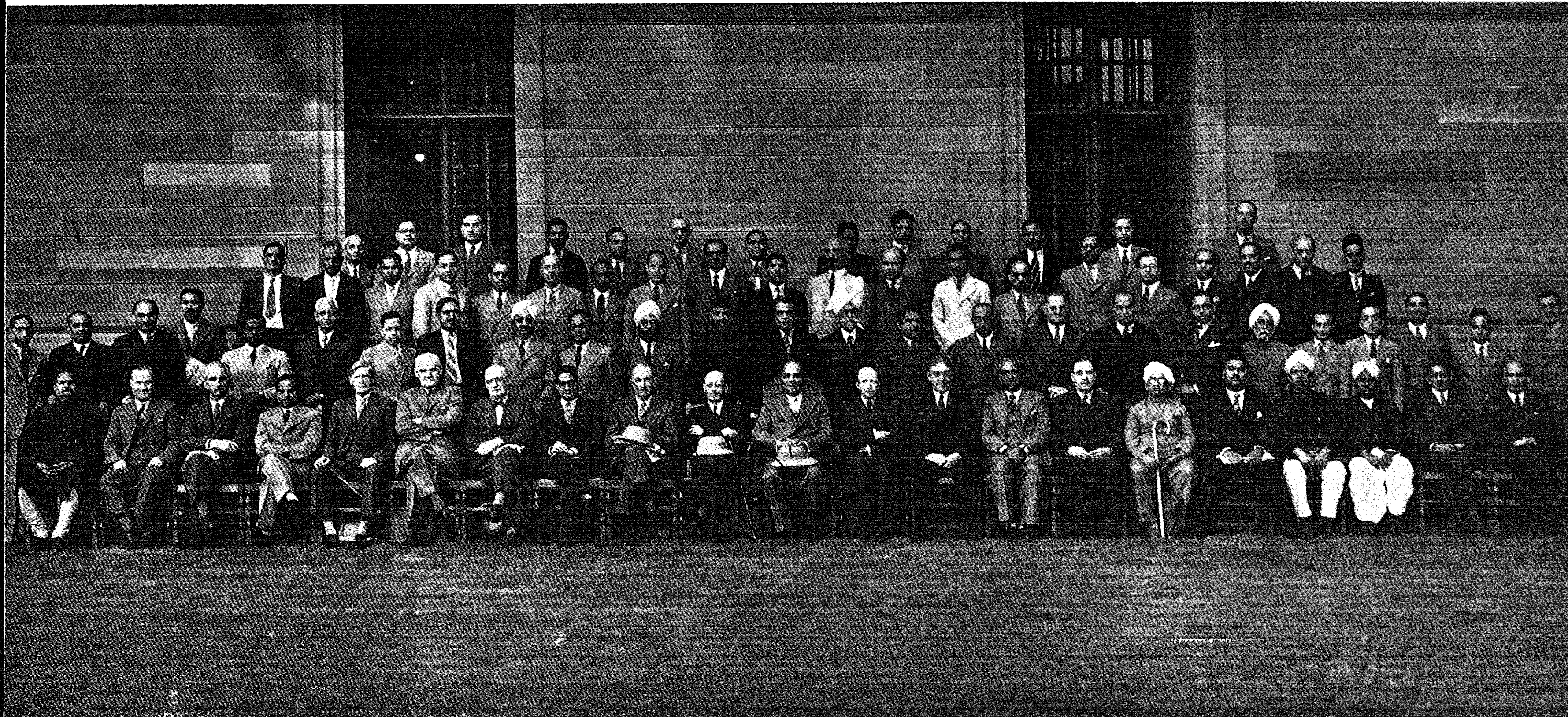
Elementary Agriculture, published by General Printers and Publishers, Calcutta.

In addition, he contributed scientific articles to newspapers and periodicals.

He was a member of the Rice Research

BOARD OF AGRICULTURE & ANIMAL HUSBANDRY IN INDIA, CROPS & SOILS WING

Fourth Meeting, February 1942



Simla Studios, New Del

st row—standing (*from left to right*) :—Mr G. S. Kulkarni (V), Mr K. M. Thomas (V), Dr B. N. Uppal (M), Mr C. A. Joseph (M), Dr R. D. Rege (V), S. Davar T. K. Modi (M) Mr D. G. Walawalkar (V), Mr K. Ramiah (V), Mr Boshi Sen (V), Mr B. Sahay (*Secretary*), Dr A. K. Mitra (M), Mr P. K. Dey (V) Mr H. W. Stewart (M).

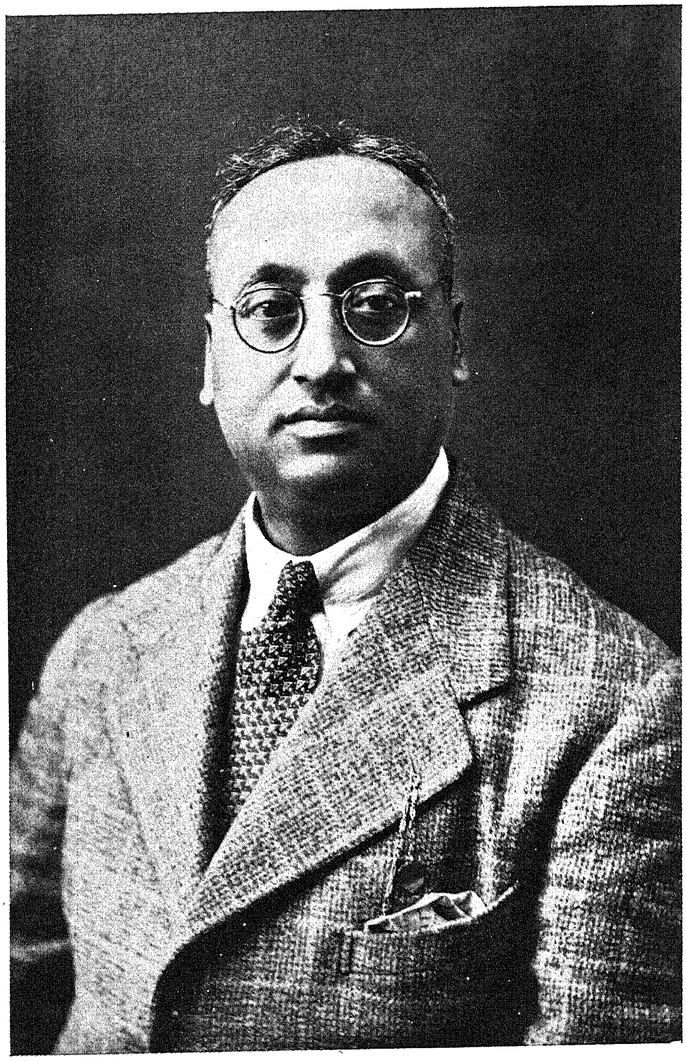
nd row—standing :—R. B. Dr D. V. Bal (M), R. S. V. V. Shirgaonkar (M), R. S. P. S. Viswanathan (M), Dr K. C. Sen (V), Mr R. L. Kaura (V), Mr B. K. Badami (V), Mr P. Israel (M Dr B. P. Pal (M), Dr B. S. Kadam (M), Dr P. V. Sukhatme (V), Mr A. B. Mehta (M), Dr E. S. Narayanan (M), Mr M. Patnaik (M), Rai Mohindra Bahadur (M), Mr R. D. Bose (M Mr F. M. de Mello (V), Mr L. S. S. Kumar (M), Mr S. S. Bhat (M), Dr S. V. Desai (M), Mr N. V. Joshi (V).

rd row—standing :—Dr T. J. Mirchandani (M), Dr S. Hedayatullah (M), Dr B. L. Sethi (M), Dr H. Chaudhuri (M), Dr P. J. Gregory (M), Mr H. B. Rajdev (M), Dr J. K. Basu (M Dr Taskhir Ahmed (M), Dr V.K. Badami (M), Mr S.C. Roy (V), Dr H.S. Pruthi (M), K.B. Mohd. Chisti (M), Dr B.B. Mundkur (M), K.B.M. Fateh-ud-Din (M), Dr S. Ramanujam (M Dr J.S. Patel (M), Mr Mason Vaugh (M), Dr Khan A. Rahman (M), Mr B.P. Akhaury (M), S. Harchand Singh (M), Dr R.S. Vasudeva (V), Mr L.S. Charak (M), Dr R.J. Kalamkar (M Dr L. A. Ramdas (M), Dr B. T. Mulwani (M).

th row—sitting :—Ch. Mukhtar Singh (M), Mr W. M. Clark (M), Mr Roger Thomas (M), Mr K. R. Narayana Iyer (M), Mr R. G. Allan (V), Sir William Roberts (M), Mr P. H. Carpenter (M Dr N. Das (M), Mr. F. Ware (M), Mr P. M. Kharegat (*Chairman*), The Hon'ble Mr N. R. Sarker (H.M.), Dr W. Burns (M), Dr Sam Higginbottom (M), R. B. B. Viswanath (M Mr H. R. Stewart (M), Sir T. S. Venkataraman (M), R. B. Shyamnandan Sahay (M), R. B. G. N. Rangaswami Ayyangar (M), Mr G. R. Nalavadi (M), Dr J. N. Mukherjee (M R. S. Kalidas Sawhney (M).

I—Member. V—Visitor.

[PLATE (



S. K. Mitra, M.Sc., Ph.D., I.A.S.
Late Director of Agriculture, Assam

PLATE 64

Committee of the Imperial Council of Agricultural Research, and as Director was on its Advisory Board. His genial presence at the gatherings of the Council will be greatly missed. The good wishes of all his friends go with him in his retirement.—(W.B.).

SCIENCE AND WORLD ORDER

THE sooner we realize to the full that the aftermath of this war will bring with it the necessity for wisdom and vision in world-planning such as has never before been shown in man's history, the better will it be for us, for our descendants, and for the world at large. And it must be no mere intellectual assent which we give to the proposition that world-planning and a study of world-needs are vital necessities if our civilization is to survive the tragedy which has befallen it. Out intellectual knowledge must be informed with something of a religious enthusiasm; we must think with our hearts as well as with our heads.—Professor Allan Ferguson in *The Listener*, 25 September 1941.

Original Articles

PRODUCE MORE FOOD CROPS*

By THE HON'BLE MR N. R. SARKER

Member for Education, Health and Lands in the Government of India

THIS is the first occasion since my assumption of office that I have the honour of meeting you and it is with sincere pleasure that I extend to you a hearty welcome both on my behalf and on behalf of the Government of India. One of my predecessors aptly described your Board as a sort of Agricultural Parliament of India and I am indeed glad to have this opportunity of meeting its members assembled here this morning from all parts of the country.

India—arsenal of the East

For the second time in succession you are meeting under the shadow of the present war which in its mad career is spreading fire throughout the length and breadth of this unhappy world. The bitter lessons that we are learning from it serve to emphasize that a nation can neglect its agriculture only at its peril. At such a time the important problem that faces any country, particularly a country which is in the front line of such a gigantic war, is to keep its fighting forces fully supplied with the best of food in order to sustain their health and spirits. The last war was won by starving the enemy both at the front and at home as a result of effective British blockade. In a total war like the present one, the possibility of food shortage is to be avoided by all means because of the demoralization and discontent it may create in the civil population. To keep them well fed is, therefore, one of the most vital of war efforts.

There is one aspect of crop planning to which I would like to draw your attention. India has become the arsenal of the East and the variety of raw material required by the war industries may differ widely from normal peace-time needs. Your advice as to the best means of achieving some flexibility in crop production to meet war-time requirements, without making it difficult to revert when the time comes to normal peace-time needs would be extremely valuable.

As regards our peace-time agricultural programme, I may just remind you that one of the chief defects of our economic system is too much dependence on agricultural production raised mainly for export purposes. Everybody in the country will agree that if we have to live as a healthy nation and if the standard of living of our ill-nourished and ill-clothed teeming millions is to be raised, the national income must be increased many times. This cannot be achieved unless there is a balance between our agricultural and industrial production. I have always been an ardent advocate of rapid industrialization of the country, but thereby I do not for a moment underrate the importance of agriculture. I am convinced that no economy would be able to stand the strain of the post-war period if it is over-weighted on either the industrial or the agricultural side. What is wanted is what I may describe as 'a rural-urban balance'. In order to bring this about, agriculture has to be so planned that next to production of enough food for the people it produces raw materials required for industrial development best suited to our national economy.

Role of scientific agriculture

Moreover, for the fulfilment of our national objective, I am most anxious to see that in so far as scientific agriculture is adaptable to Indian conditions the methods and practices of our cultivators should not lag behind those of his confréres in advanced countries where up-to-date scientific agriculture is practised.

* Opening address delivered at the meeting of the Crops and Soils Wing of the Board of Agriculture and Animals Husbandry on 18 February 1942.

Indian agriculture should not only be a handmaid to our industry, but should also be able to hold its own against undue encroachment by the latter and competition from the outside world. Your Board, I am sure, can make a large contribution to the achievement of this objective.

I observe that you have before you an interesting agenda covering a variety of subjects, of both practical and scientific importance. Your agenda is an index of the wide range and complexity of the problems upon a satisfactory solution of which the development of scientific and efficient agriculture is possible. It is not for me, a layman, to offer any advice or guidance on these problems to the galaxy of experts I see around me this morning. But I am particularly interested in item No. 10 (New Economic Crops). The exigencies of war, by cutting off many of our overseas markets, have created a serious problem regarding the disposal of surplus stocks of some of the commercial crops. We have been particularly hard hit by entry into the war of Japan, which used to take a very large portion of our short-staple cotton. Government at the moment is considering the question as to how best to deal with our surplus stock of this crop. There are similar stocks of groundnut and other seeds produced mainly for export purposes. This problem, as you know, has baffled the statesmen and experts of many countries.

New economic crops

The matter does not end with the disposal of surplus stocks. It must be followed by some adjustment of crop acreages to avoid fall in prices and recurrence of the problem in future, but it is not easy to find suitable substitutes for the prevailing cash crops acceptable to cultivators. If, as a result of your deliberations, you can recommend with confidence some new economic crops suitable for being raised in lands released from, say short-staple cotton, jute and groundnut for which markets are available or may be easily created, you will have done a real service to help Indian agriculture at this crucial period in its history. I shall eagerly await the result of your deliberations.

In this connection I may mention one serious and immediate problem, the threatened shortage of rice owing to the risk of normal supply from Burma being partially cut off. As you are aware, the imports of rice from Burma averaged during the last five years over $1\frac{1}{2}$ million tons. To make good this deficiency, it seems to me imperative, bearing in mind the supreme importance of keeping the civil population well fed, that an energetic drive should be undertaken forthwith for the production of more food crops, and I express the hope that the provincial and state Departments of Agriculture will seriously consider the desirability of advising cultivators to grow suitable food crops in lands released from cash crops whose cultivation on the previous scale has become uneconomic. I am conscious of the many pitfalls to be avoided in giving this advice to the cultivators.

Grow more food

In the absence of normal transport facilities, not only over-production in India as a whole, but also over-production in particular regions should be avoided, as otherwise it may result in a serious fall in agricultural prices in particular regions to the disadvantage of cultivators. But the price level being as it is and conditions today being what they are, I hazard the opinion that no undue risk is involved in advocating a cautious expansion of acreage under food crops in lands which have become surplus for the production of commercial crops, to build up reserves of food stocks against the rainy day and to make India self-sufficient in this respect.

These are, however, short-range problems. The important long-range problem on which, in due course, your advice will be invaluable is that of formulating an agricultural policy for India during the post-war period of reconstruction, to one aspect of which I have already referred in an earlier part of my speech. It is impossible to visualize the conditions which will prevail in the world at the end of the war, when complete victory has been won by the Allies over the formidable forces of the Axis powers ranged against them. But whatever they may be, we must prepare ourselves for the gigantic task that will face us then in clearing up the debris left behind by

the devastation caused by the war and to repair the infinite damage which is being caused to world economy. We were caught napping when war came; let us not be caught napping when peace comes. I, therefore, adjure you, gentlemen, who are experts in different branches of agricultural science, that even from now you should apply your mind to this stupendous problem awaiting us. Each in your own way may think out how best agriculture should be reorganized in the post-war world so that it may make the best use of the land, which is after all our most precious inheritance, and play a worthy part in the new world order for the dawn of which we are so eagerly waiting.

With these words, gentlemen, I leave you to your deliberations which, under the able guidance of your Chairman will, I am confident, bear fruitful results.

AGRICULTURAL EDUCATION

By W. M. Clark, M.B.E., B.Sc., I.A.S.
Principal, Bengal Agricultural Research Institute, Dacca

THE importance given to the subject by placing it first on the agenda was welcomed by Dr Sam Higginbottom, the distinguished Principal of the Allahabad Agricultural College, and one who has himself contributed much to the advancement of agricultural education in India. The honour of reviewing the history of such work in India, and of leading discussion on it at the Board of Agriculture and Animal Husbandry, was accorded to the writer, whose fortune it has been to be associated with the opening of the Agricultural College, Mandalay, Burma, in 1924, and to be the first Principal of what is, at present, the newest Institute offering education of degree standard, namely the Bengal Agricultural Institute at Dacca.

Interesting discussion

The writer had submitted a printed note or address and similar notes were contributed by Mr B. S. Patel, I.A.S., Principal of the College of Agriculture at Poona; by Mr C. V. Sane, Deputy Director of Agriculture, Baroda State; by Sir William Roberts, C.I.E., Head of the British Cotton Growing Association, Khanewal; and finally, by Mr Roger Thomas, C.I.E., of Sind Land Development Co., Ltd. The interest of these latter two gentlemen deserves special note. Both were formerly members of the Indian Agricultural Service, Sir William having been Professor of Agriculture and Principal at the Lyallpur Agricultural College, but since then they have become interested in the commercial development of Indian agriculture, and it is that fact which gives their continued interest in agricultural education its importance. Unless the subject had value for the future development of India—using the word 'development' in its widest sense—it is to be presumed that these two gentlemen would not have been so keenly interested in it.

Among others who took part in the two-hour discussion which followed the writer's preliminary remarks were Mr Ware, Animal Husbandry Commissioner with the Government of India, Dr Mirchandani, Rai Bahadur S. Sahay, Dr Mulwani, Chaudhuri Mukhtar Singh, Prof. J. N. Mukherjee and Mr R. G. Allan. Many others no doubt would have spoken if time had allowed and there was immediate agreement, when the Board resumed its deliberations at 2-30 p.m., to a proposal made by Sir William Roberts that a Committee be formed to frame resolutions. The members of that Committee sat for an hour the next morning and then for three hours in the evening, after the finish of the discussions put down for the second day, in order to carry out the duty laid on them. The members of the Committee were Mr Kharegat, Dr Burns, Dr Higginbottom, Sir William Roberts, Chaudhuri Mukhtar Singh, Prof. J. N. Mukherjee, Mr Roger Thomas, Dr Bal, Rai Bahadur S. Sahay, Khan Bahadur Maulvi Fateh-ud-Din and the writer.

Recording a discussion to make it live as a picture in words is believed to be a difficult task even for a trained reporter, and is perhaps beyond the powers of one to whom the writing of articles is only an addition to duties, but the range of the speeches may perhaps be indicated by noting the points stressed by the various speakers.

History of education

The writer in his printed note or address to which, unfortunately for such readers as were present at the discussion rather lengthy reference must be made, began by pointing out that formal teaching in a College had never been a popular form of activity with district officers of the Indian Agricultural Service, practically all of whom preferred the continuous process of informal, and perhaps not consciously recognized, teaching of their touring life in field and village. He suggested

that discussion at this meeting might be restricted to formal teaching in order to keep the subject within manageable bounds.

The history of the subject in India was noted as beginning with a recommendation made by the Famine Commissioners in 1880, carried a stage further at an agricultural conference held in 1888 and, finally, as being given a framework in 1890 after consideration of a report by Dr Voelcker, the famous Consulting Chemist to the Royal Agricultural Society of England, after the tour he had been asked to make in India. The fact that the teaching of agriculture, even in Europe and the United States, did not really begin to be effective until after 1890 was pointed out as a matter of interest, and as another illustration that teaching can only be based on a body of knowledge. In agricultural science the accumulation may be said to have begun only about 1840 from which year, as was recently pointed out in *Nature*, the process of photo-synthesis was first universally recognized. Fifty years after, it became possible to give effective teaching in Europe and the United States of America. Work in India had begun long before 1890, notably at Saidapet in Madras and at Baroda, but there was little enough on which to base teaching in 1899, when Poona began teaching to degree standard, or even in 1917 at Lyallpur.

Educational policy

Finally, in order that there might be a means of comparing the needs of today with those of 1890, the resolutions passed at this first conference on agricultural education in India were given and are repeated below:

1. In considering the question of agricultural education and progress, the Committee desire to express the opinion that it is most desirable to extend primary education among the agricultural classes.

2. That, as a general rule, instruction in agriculture should be combined with the existing course of education, and not depend exclusively on separate special institutions.

3. Resolved that it is most desirable that the universities should recognize the science of agriculture as an optional subject in the course for a degree.

4. That it is very desirable that the elementary principles of agriculture should form a prominent subject in the education which is given in village schools with a view to creating more interest in agricultural improvement amongst the cultivating classes.

5. Resolved that, in order to secure the object of the last resolution, it is desirable to take early steps to provide suitable teaching, the best books and 'readers'.

6. It is highly desirable that the claims of men trained in scientific agriculture to appointments in the Revenue and cognate departments should be as freely recognized as those of men trained in law, arts and engineering.

7. That where appointments in the Revenue and cognate departments are made on the result of competitive examinations, scientific agriculture should be included as an optional or necessary subject in the examination course.

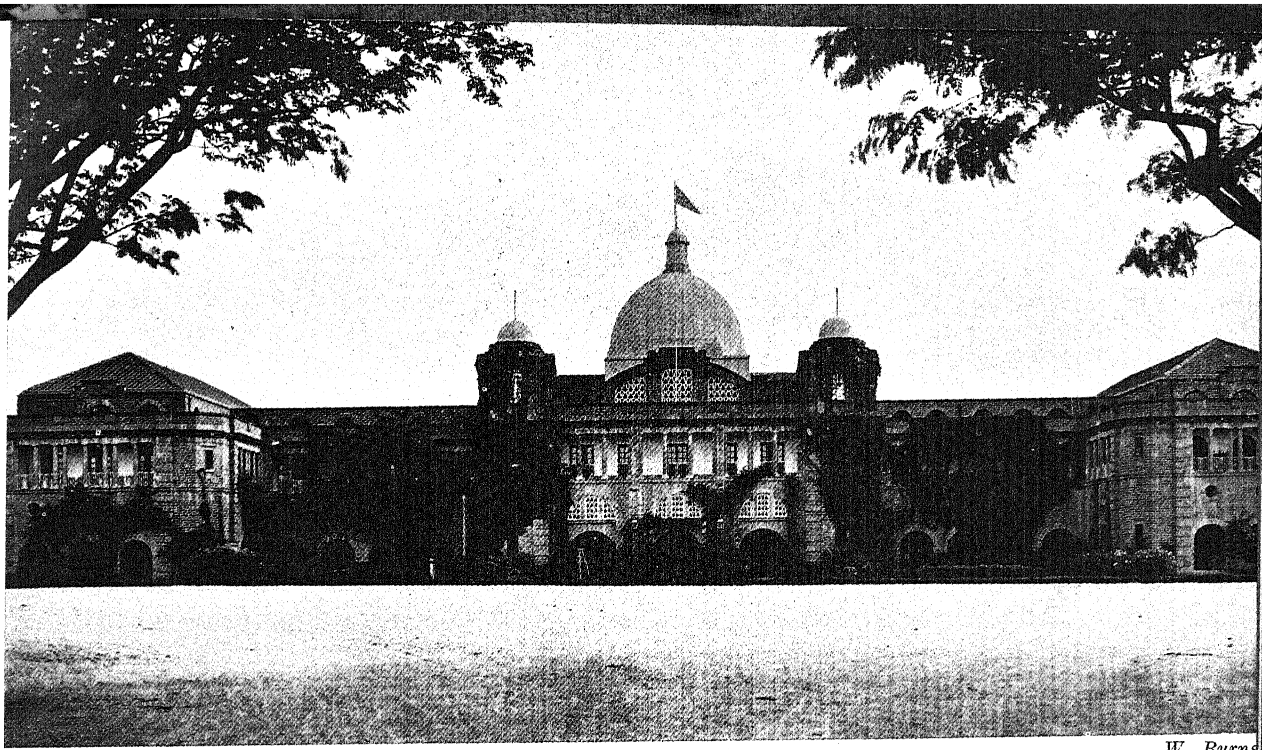
8. Resolved that in any province in which it may be determined to introduce a scheme for higher agricultural education, no arrangements will be satisfactory which do not provide (*a*) for a thoroughly practical training of the students in the field and laboratory as distinct from theory or practice as taught in the lecture room, and (*b*) for examination tests of a special and searching character in the above branches of work.

The writer then went on to state the difficulties experienced over textbooks, and still experienced by those who have to teach, the lengthening of college courses which took place in all provinces in order to turn out the kind of men required and, finally, the shifts and changes made in dealing with agriculture as a subject in schools and the virtual stagnation reached in all provinces with this aspect of the subject. It was argued also that there was no need to discuss 'vocational' training as, given the need, the money and the teaching staff, no difficulty was now experienced in meeting requirements.

All-India textbook

As concrete proposals upon which resolutions might be framed the writer put forward arguments in favour of the following:

(1) A textbook on an all-India basis. The



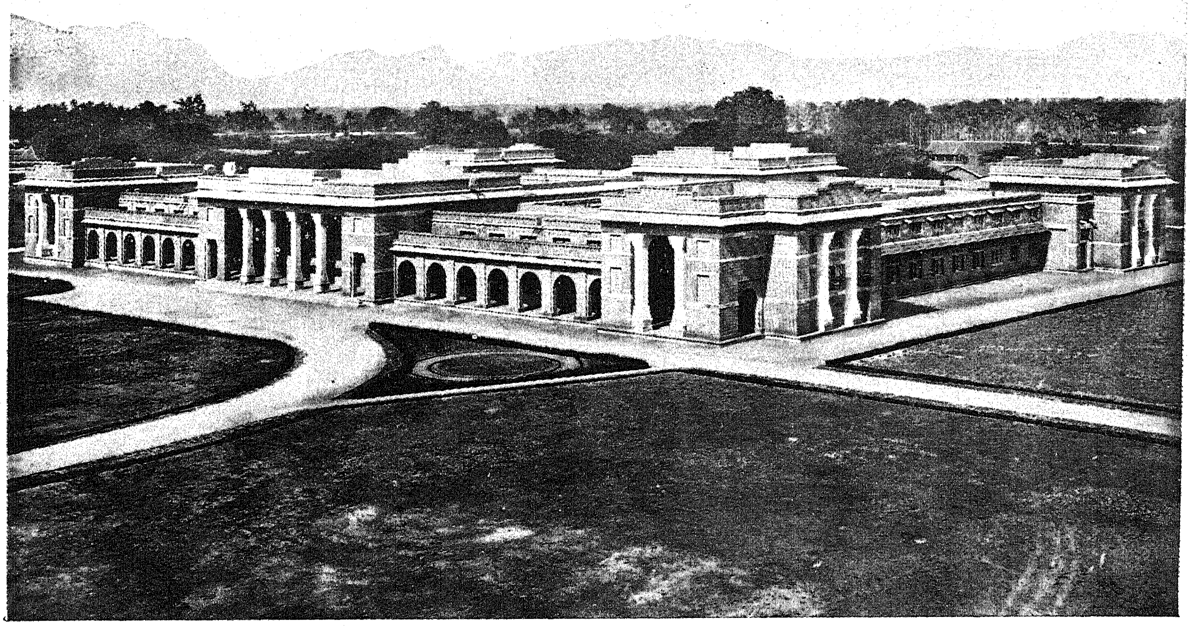
W. Burns

Poona College of Agriculture

PLATE 65

Practical work in gardening of the Home Making class at the Agricultural Institute, Allahabad.

J. N. Warne



Agricultural College, Coimbatore

Students at work in the Dairy at the Agricultural College, Coimbatore

PLATE 66

term 'textbook' was an unfortunate choice, and was rightly criticised in the subsequent discussion, even although the writer tried to make it clear in his opening remarks that what he really had in view, for basic use in all colleges, was something in the nature of an encyclopaedia of Indian agriculture.

Mr Ware could not stay throughout the discussion, but argued before he left that, as animal husbandry was based on the three main sciences of genetics, nutrition and medicine, the subject required a separate book which, he suggested, might be divided into four sections, namely Breeding, Feeding, Animal Management and Hygiene (including housing and preventive medicine) and Dairying.

Dr Higginbottom raised a laugh by stating that a textbook for use all over India would be 'some book' and something in the nature of an agricultural Bible. He further argued for books of more limited regional scope, sectionalized under such heads as Soils, Agronomy, Horticulture, Animal Husbandry, Dairy Products and Agricultural Economics including costs and marketing.

Prof. Mukherjee also spoke on this aspect of the subject and argued on the need for a stock-taking and welcomed the idea of what he called a compendium of available knowledge on Indian agriculture.

Finally, Dr Burns, speaking with authority as Agricultural Commissioner, stated that he was inclined to welcome what the leader of the discussion had now described as an encyclopaedia of Indian agriculture, something fundamental which would cover all India as, for example, had Sir George Watt's outstandingly useful publication, *Dictionary of the Economic Products of India* now, unfortunately, out of print.

As will be seen from the resolution actually passed and given at the end of this article the need for such an all-India publication was agreed on.

Relations with universities

(2) The second proposition put up questioned the wisdom of continuing to deal with agricultural education of a university standard departmentally.

The writer argued that members of the agricultural services could all be 100 per cent efficient, as teachers, in two spheres only—Deputy Directors of Agriculture, as teachers of the *practice* of agriculture and Chemists, Botanists and other headquarters research workers, as the guides of students undertaking *postgraduate* research work. He proposed, therefore, that no student should be allowed to graduate in the ordinary degree in agriculture, unless he could present to the examiners a certificate that he had put in a continuous twelve months of practice as a student-labourer on a Government farm. All other teaching, including that in agriculture, could be given, he argued, in the universities and to a much greater number of boys than now take it in the special agricultural colleges.

The proposal found no supporter and was even strongly opposed by such knowledgeable workers as Dr Burns and Dr Higginbottom on the score of being unworkable in India, at any rate at present, likely to be ineffective in securing the necessary practice, and even basically unsound in that practice and theory would not march hand in hand. Other workers thought that in the colleges affiliated to the examining universities there would be a danger of cheap and incompetent teaching, a question to which Sir William Roberts had drawn attention in his note where he pleaded for more financial encouragement for teachers of the right type.

The writer is not convinced that, with the cooperation of the universities to ensure teaching of a high standard, his proposals would not be to the ultimate benefit of the subject and the cultural knowledge of the nation, but he was content, in view of the beliefs held, some of which he had to acknowledge as weighty, that there should be no resolution. The proposal will be none the worse for further study.

Adequate salaries

(3) Two other items were lumped together under one head, first, (as is practically the case in Bengal) to make the starting point in all Government scales for graduates the same, and second, to have no separate public examination for posts in the Revenue and cognate

services. The final salaries in these are higher than in, for example, the agricultural services and it was argued that these Revenue services should have within their ranks members drawn proportionately from all faculties in the universities from which they draw their recruits. The graduates standing at the top in all faculties would simply offer themselves for an interview if desirous of entering the revenue service. It was thought that, by so doing, students and their parents would elect to enter upon an agreeable course of study, and not have the issue confused by considerations of how best to secure a particular salary. At the back of the proposal of course is the idea that recruitment on such a basis would provide the various Governments with district officers capable of giving a lead on a broader front than is perhaps now possible.

Oddly enough no one spoke actually to the point on this particular issue, but Mr Sahay's observation, that the resolutions passed in 1890 could hardly be bettered, and that what was wanted was to have them all put into effect, met with general approval. As will be seen the resolution actually framed proposed only a minor change in existing practice, namely to have agriculture, agricultural chemistry and agricultural botany included among the subjects which might be offered at public service examinations. If not all that the writer wished, it is a move in the right direction.

Nature study in schools

(4) The fourth proposition questioned the value of the teaching given in a few schools in each province under the heading 'Agriculture'.

As Dr Higginbottom pointed out, all agricultural education must be expensive and, although he did not say so, that is probably the chief reason why agriculture as a subject in schools has shown no signs of expanding for at least 10 years. Dr Higginbottom wanted all elementary schools to have a garden, however, and referred to the tremendous success of education so based in the Philippines. Mr Allan agreed that agriculture, as such, was not valuable in schools, but seemed to consider that the primary defect lay in the training given to the teachers who taught it. Mr Roger Thomas perhaps got nearest to what all felt to be necessary when he stressed, early in the debate, the importance of aiming in schools, not at agriculture, as a subject, but at inculcating a spirit of inquisitiveness. He also complained of a lack of books on natural history. It was noted later, however, by Dr Burns that in several provinces quite good textbooks on nature study did exist, including some (along with teachers' handbooks) prepared by himself, although perhaps not now in use.

The arguments in committee on this question were, to the writer at any rate, perhaps the most interesting of all. Mr Kharegat, as a basis for the formulation of opinion, suggested consideration of a resolution advocating more time being spent on nature study in rural schools. As will be seen the words 'elementary science' rather than 'nature study' were stressed in the resolution passed and the word 'rural' was eliminated as likely to create a needless difference between rural and town schools. Reference was made to the position created in England where a population had arisen in the towns to whom a bad harvest meant nothing at all and agriculture a matter of little importance to the nation. The article in *Nature* of 15 November 1941 already referred to should be read by all interested in this important matter.

National labour projects

(5) As a final proposal it was suggested that India would benefit immensely by making six months' work on a labour project of national importance, e.g. work on a soil erosion project and the re-creation of Bengal's dead canal system, compulsory for all university students, immediately after passing their Intermediate Arts or Science examinations, and before they were allowed to proceed further in their studies. It was noted as a tune which Hitler had adopted and caused to be played in Germany, but there was no reason why the 'Devil' should have all the best tunes.

As nobody commented on it the idea is perhaps not such a good one as the writer thought it to be.

Resolution

The resolutions finally agreed to were worded as under:

(1) In order to make the youth agriculture-minded, elementary science, based on the study of local plants and animals, should be given prominence in the curricula of middle schools. To attain this object the available books on nature study suitable for the use and guidance of teachers should be considerably augmented on a nation-wide scale to meet regional needs.

(2) Special agricultural courses, of varying duration, may be started where facilities exist, for the sons of farmers, where they can be given agricultural knowledge and taught good farming practices, so that they may become better agriculturists.

(3) The agricultural education of farmers should be carried out by means of special extension courses to supplement the propaganda and demonstrations done by the staff of the Agricultural Departments. For carrying out this work, the staff should (*a*) make specific recommendations that should be adopted by farmers, (*b*) have received training in methods of agricultural propaganda and demonstration, (*c*) have an aptitude for organizing farmers, and (*d*) attend suitable refresher courses from time to time.

(4) As the rapid advance in all the sciences basic to agriculture may have a tendency to relegate agriculture itself to a secondary position in the college course, emphasis should be laid in the education imparted in agricultural colleges on economic and practical field work.

(5) The research staff should be such as have received postgraduate training in research matters and a special aptitude for research.

(6) The teaching staff of agricultural colleges should be selected so as to ensure that teachers are also workers in their own particular subject and have the gift of imparting knowledge.

(7) The pay and prospects of the agricultural staff should not be inferior to those of other departments. In particular, men trained in scientific agriculture should be eligible for public service examinations and for appointments in the Revenue and cognate departments in the same way as those trained in arts, law, etc. For this purpose agriculture, agricultural chemistry and agricultural botany should be recognized as subjects which may be offered for public service examinations.

(8) A manual of Indian Agriculture and Animal Husbandry in several sections based on Indian experience and a critical examination of the data available should be prepared under the aegis of the I. C. A. R. In addition there should be agricultural textbooks for the different provinces or regions to suit local requirements, in which local terminology is used.

The above ends the account of the more outstanding features of the discussion as proposed by the leader, but it is by no means comprehensive even on these points, and, as is clear from the resolutions passed, makes no mention of items considered to be of equal or greater importance by those who raised them.

Use of agricultural economics

Several speakers, including Chaudhuri Mukhtar Singh, Mr Roger Thomas and Prof. J. N. Mukherjee, considered that much more was required to be done in agricultural colleges on the subject of agricultural economics. The writer can only agree, but has been puzzled how best to make it a *live* issue in a college course, and has been tentatively of the opinion that it was, perhaps, best studied in college through detailed accumulation and study of costings, and by village studies such as those for which the Punjab has long been noted. Against that is the fact that, without formal introduction to the science of economics, it is impossible to obtain the wide outlook necessary before effective work can be done on the aspect or aspects of it known as agricultural economics. It is, for example, difficult to design an M.Sc. or M.Ag. course by thesis. Proposals on the question in this journal would be welcome.

Underlining the general agreement with the remarks noted in the above paragraph, Dr Burns made the interesting suggestion that graduates should be encouraged to go for employment and training as assistants on

large estates and thereby secure the practical outlook necessary in whatever line of employment they undertook. He considered that, among other things, it would be a useful form of training for men likely to become Deputy Directors of Agriculture.

Mr Sahay, in referring to previous remarks, stated his belief that we need not fear turning out too many graduates in agriculture. Such as might be disinclined to live in villages and farm with their own hands would do so when conditions made it necessary.

Mr Thomas had some interesting comment to make on the value of some of the propaganda work being done in the villages. He had little use for the cinema, except as a means for drawing a crowd, while much of the propaganda, he considered, showed little knowledge of the mental make-up of the man for whom it was designed. Nobody mentioned the value of wireless, a matter on which the writer would have liked some comment as he is inclined to doubt the possibility of teaching cultivators through their ears, and to wonder if it would not be wiser, as an aid in the educational efforts of all departments, to subsidize the printing and distribution of weekly or monthly papers consisting largely of pictures drawn from all over the world and not necessarily agricultural pictures. That, again, is a subject upon which articles in this magazine would be welcome.

SOIL FERTILITY

By J. K. Basu, M. Sc. (Cal.), Ph.D. (Lond.)

Soil Physicist, Sugarcane Research Scheme for the Deccan, Padegaon

PROBLEMS connected with soil fertility form some of the most fascinating yet extremely complicated studies in the domains of soil science and agronomy in modern times. 'Soil fertility' can be defined as the resultant of a group of certain complex intrinsic soil properties which is responsible for the field behaviour and final yields of crops. Such a definition will naturally make it dependent on all the external and internal factors which govern plant growth, namely (1) climate, (2) soil type, (3) adaptability of crops, and (4) cultural practices. Hence in defining the fertility of a soil of a particular locality the above conditions must be specified.

Historical development

Various theories have been put forth from time to time regarding soil fertility. The oldest is the 'chemical' or 'available plant food' theory. Starting with de Saussure (1804) who showed that carbon is taken up by plants from the air, Boussinghault (1834), Liebig (1840), Lawes and Gilbert (1847) proved that nitrogen, potash, phosphoric acid, calcium, magnesium, iron, etc. are all essential for plant growth and that these substances are derived from the soil. Following Liebig and Liebscher, Mitscherlich (1909) worked out the mathematical side of the problem and stated the law that increase in yield produced by a given increase in the growth factor was proportional to the decrement from the minimum yield which was obtained by increasing that particular factor. Later in the hands of Baule (1918) and others it developed into the science of agrobiology wherein a claim for a universal scale for measuring soil fertility has been made. According to this science, an ideal perfertile soil has been defined as a soil (containing 2,250 lb. N, 450 lb. P and 820 lb. K per acre) which would give the highest possible yields of all crops. In a vastly complicated system like a soil, however, such idealism cannot be entertained at the present stage of our knowledge of soil science.

Next in importance come the 'physical theories' of soil fertility originally worked out by Davy and Schübler (1838). Later the question of fixation of atmospheric nitrogen by leguminous plants was established by Hellriegel and Wilfarth (1886) as due to nodule organisms present in the roots of these plants. Other brilliant researches soon followed when various nitrogen-fixing organisms were discovered by Winogradsky (1895) and Beijerinck (1901). Early in the last century de Candolle formulated the hypothesis that plantsexcrete from their roots toxins which may prove harmful to other crops. But this was not substantiated by later researches. Other investigators working in this field, however, demonstrated that negative factors do exist in soils which may adversely affect the growth of plants. Simultaneously when these theories were being propounded in various parts of the world, a batch of brilliant soil workers in Russia (special mention may be made of Docuchaiev—1879, Glinka—1914, and Gedroiz—1929) who attempted to co-ordinate all the above factors of soil fertility into a single comprehensive concept of soil type. According to these workers, a soil type is an independent entity which will respond in a particular fashion to climate, crops and cultural practices. In order to characterize a soil type it is necessary that all the various factors of soil fertility must be determined taking a soil profile as a unit of study.

Four fertility factors

The measurable fertility factors, both positive and negative, can be classed under the following heads:

I. Physical condition.
II. Organic matter and micro-organisms.
III. Available plant nutrients.
IV. Toxic substances.

The physical aspect of the soil has perhaps the most important bearing on fertility as it provides the environment in which the vital biological activities can proceed in the soil by which nutrient substances are made available to the plant. A favourable physical condition of the soil thus involves an optimum air and water regime and a suitable medium for the support and development of the root system. The main factors which govern this condition are (1) texture, (2) structure, (3) drainage, (4) reaction and (5) colloids. The 'textural class' of the soil based on mechanical analysis, such as heavy clay, clay, loam, sand, etc. is a useful indication and is considered as a routine determination in soil assessment.

The structure of the soil refers to the arrangement of the individual particles within the soil mass into aggregates of different shape, size and pattern. From the point of view of actual crop production various techniques for quantitative studies on structure have been developed, based on the determination of such properties as (i) permeability, (ii) porosity, and (iii) the direct separation and determination of different-sized aggregates, called aggregate analysis. The most promising method of assessing soil structure has been afforded by aggregate analysis, to which the determination of their stability under the action of rain or irrigation water or cultivation implements has been recently added as an important corollary.

The morphological study of the soil in the field accompanied by quantitative measurements of pore space, compaction, percolation, etc. provide the best available methods for studying the drainage condition. In U. S. A., in rating the agricultural value of soils, these studies are given great importance.

This property is useful in providing information about soil fertility as it regulates the biological activities of the soil. Experiments with soil or sand cultures have shown that a *p*H of 6·0 to 8·0 is suitable for most agricultural plants and a *p*H within these limits will not seriously impair the fertility of the soil. However, it may be necessary to adjust crops according to the reaction that they are best suited to.

Probably the most important agronomic characteristics of soils depend on the quantity and quality of colloids present. Soil colloids are of two kinds: (i) inorganic, consisting of the highly weathered portion of the mineral matter, existing mostly in the clay fraction, and (ii) organic, represented probably by the 'lignin-humus' fraction. These two kinds of substances function jointly in the soil and are collectively termed the 'clay-humus' complex, the 'colloid complex' or the 'absorbing complex'. The bearing which the colloid-complex has on fertility is in two important directions: one is that, due to its absorptive properties, it behaves as a natural reservoir for plant-food ingredients of the soil such as Ca, K, NH_4, and other bases. These are held by it against the leaching action of water and gradually released to the plant by base exchange. Secondly, the physical properties of the soil are greatly influenced by the proportion of colloids in soil and the nature and amount of bases which are in combination with them.

Organic matter

The role of different organisms in the process of decomposition of organic matter and in the synthesis of available plant food is too well known for elaboration here. It is for this reason that upon the effective utilization of soil organic matter depends the fertility of a soil to a very great extent, especially in climates where normally its level is very low. A close relationship between soil fertility on the one hand, and soil organic matter and micro-organisms on the other is, therefore, evident. The determination of soil organic matter thus forms an important factor in assessing soil fertility.

The most widely used method of characterizing organic matter in the soil is to express it as the ratio carbon: nitrogen. Attempts at correlating this ratio to soil fertility have been made by various workers. A ratio of about 10·0 or below is supposed to be correlated with more fertile soils, whereas a higher ratio is correlated with the less fertile soils. The beneficial ratio for crop growth, however, may depend to a certain extent on the climate and soil group. Experiments on

black cotton soil at Padegaon indicate that soils having ratios higher than 15·0 are the ones which are showing signs of deterioration under cane growing. Further work on this line is indicated on different soil groups and under different climatic conditions. Efforts to correlate numbers of bacteria with soil fertility have usually failed. There are several methods of counting soil bacteria, none of which gives absolute values. The carbon dioxide evolution method may prove superior in characterizing a soil, and more work in this line is desirable in India with a view to correlating soil fertility and crop yields.

Plant nutrients

The importance of the physical and other aspects of soil fertility have been described, but the final effect of all those conditions can only be judged by the nutrients that are actually supplied to the growing plant. The supply of nutrient substances is thus the ultimate criterion whether all the different factors are operating in favour of the plant.

It has been pointed out that, among the host of elements that are taken up by the plant from the soil, N, P and K are usually the constituents that fall short of requirements and, therefore, the availability of these substances is mainly considered. All the methods of such determinations can be classed under three broad heads : (1) laboratory methods (2) pot-culture and lysimeter methods, and (3) field experiments. The values of the first two methods lie in the fact that they are usually quicker and less expensive than the last method but they are of very little practical utility unless they are carefully standardized against field experiments with the crops under consideration.

(1) *Laboratory methods.*—A very large number of methods has been developed under this group and it will be impossible to discuss the merits of even a small fraction of them in this note and hence only a bare outline will be given here. Broadly speaking, these methods fall under four groups—(*a*) soil solution, (*b*) extraction with chemical reagents, (*c*) extraction with plants, and (*d*) methods based on microbiological activities in soil.

(2) *Pot-culture and lysimeter methods.*—In this group of experimental methods for determining the fertility status of soils, various test crops are grown in pots or cement tanks and the yields recorded.

(3) *Field experiments.*—Since it is in the field that all these tests about soil fertility are to be finally applied it is obvious that experiments must be done ultimately on field scale. Other methods discussed previously are used as aids for field experimentation to simplify or eliminate a number of trials which are definitely going to yield negative results or prove uneconomic on large-scale farming. Statistical methods are now available for laying out field experiments which can give very precise information on the suitability of irrigation doses, manures, cropping, etc. which are required in the management and production of maximum crop yields. But in the practical applications of these methods the following important points should be borne in mind : (i) field experiments must be conducted over a sufficient number of years in order to evaluate the seasonal effects ; (ii) experiments should be conducted over well-known soil types or else where experiments have been in progress over a long time soil type identification should be done on the profile basis ; (iii) climate of the place should not be ignored while recommending the particular treatments or varieties to a new tract ; (iv) it is also necessary to keep some detailed observations on the development of crops and occurrence of insect pests and diseases. Agricultural recommendations in India have often failed in the past due to overlooking the above important factors or due to fundamental defects in the layout of the experiments. It is now time that these precautions should be observed in order to develop our methods of agricultural practice on a sound footing.

Our knowledge of the presence of toxic substances in the soil is very limited. According to Russell there is no evidence of the presence of soluble toxins in normally aerated soils sufficiently supplied with plant food and with calcium carbonate. It is true that substances which prove toxic to the plant occur mostly in abnormal soils such as in saline, alkaline, acid or waterlogged soils unless the cause is due to the presence of certain harmful

rare elements. The toxicity may, therefore, be attributed to the following factors:

(1) High concentration of salts, (2) high acidity or alkalinity, (3) presence of harmful rare elements, (4) organic toxins, and (5) harmful soil organisms.

Improving fertility

The major factors which modify the fertility of a soil under normal agricultural practices, and which can be controlled by human efforts, are (1) irrigation, (2) tillage operations, (3) crop rotations and fallow, and (4) manuring. Of these, effects of manuring depend primarily on the available plant food, physical condition and microbiological conditions of the soil.

Where water is often the limiting factor in crop production, as in India, irrigation has a profound effect on raising the level of yields. For grain and other staple crops it is often observed that yields are doubled or trebled when they are irrigated; and the greater the aridity of a tract, the more pronounced the effect of irrigation is found to be. The extent of increase in productivity by irrigation, however, is determined somewhat by the nature of the crops grown and the manuring. In most of the provinces irrigation projects of considerable magnitude are in existence in which crores of rupees have been invested. These should materially help to increase the production from the land. There is, of course, the other side to this question, that of damage being done to soil fertility by waterlogging and salt-efflorescence.

In the future reorganization of agricultural methods a close scrutiny of the existing cultivation methods is essential with a view to discriminating between those which are strictly necessary for maintaining crop yields and those which have come into practice as a matter of tradition.

The primary objects of tillage operations are (*a*) the preparation of a suitable seed-bed, (*b*) suppression of weeds, and (*c*) improvement in the physical condition for the conservation of the optimum moisture and air in the soil. Implements used for the above purposes have been broadly classified by Keen under two heads: (1) ploughs for inverting the soil, and (2) all other forms, primarily meant for stirring and comminuting action. From the physical point of view tillage operations are conducive to better tilth conditions resulting in increased microbiological activities in the soil. Thus there is an increased production of nitrate and other plant food if cultivation operations are carried out at the proper moisture conditions. On the other hand, excessive cultivation may lead to rapid destruction of organic matter and available nutrients.

Under Indian conditions it appears doubtful whether deep ploughing would be paying for most of the agricultural crops. Interculture to certain crops has proved very useful, its number depending mainly on the intensity of weed infestation and nature of soil. The use of interculture from the point of view of conservation of soil moisture is still a controversial point.

From a critical examination of the yield data of various experimental stations in America for crop rotations conducted over a long period Weir came to the conclusion that crop rotation is as important as manuring or cultivation operations in increasing crop yields. Rothamsted results also indicate that wheat in rotation yields more than when it is grown continuously, but the experiments are not very conclusive according to Sir John Russell. He claims that wheat can be grown successfully under continuous cropping if properly manured. As regards fallowing in wheat rotation, increased yields were obtained at the beginning but later yields were actually lowered below those of the continuous wheat. Greater losses of nitrate and other available constituents during the period of fallow were supposed to be the cause of such lowering in fertility.

Investigations at the Padegaon Farm conclusively demonstrate that the yields of cane were markedly influenced by the previous cropping. Thus green manuring crops were found superior to covered fallow while both of these were superior to either cotton, groundnut or *jowar*, the order of effectiveness of the rotational crops being cotton $>$ *jowar* $>$ groundnut.

AGRICULTURAL ENGINEERING IN INDIA

By M. Vaugh

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WHO is an agricultural engineer? By American practice the term is applied only to those who have pursued a definite course of training in engineering and its application to agriculture. In England, apparently so far as I can judge by literature coming to me, an agricultural engineer is one who is engaged in the marketing of agricultural implements or in their manufacture and the term does not depend on what training the individual may have had, if any at all, other than experience. So far as I can determine, in India the term is applied to any engineer without regard to the branch of engineering in which he may have been trained who is assigned to a post carrying the title of 'Agricultural Engineer', usually in Government service.

Early experiments

The early agricultural departmental organization made no provision for agricultural engineering. The men appointed were administrators from the civil service, biologists and plant breeders, or agriculturists. Many of them were exceedingly capable men and laid very fine foundations for the splendid work which has been done since. None of them was an engineer and indeed the idea of the agricultural engineer had not yet emerged in the west.

While the early officials of these newly created Agricultural Departments were not primarily trained to deal with implements, they interested themselves early in the introduction and trial of foreign implements, particularly iron ploughs. N. G. Charley, in his excellent paper presented to the Crops and Soils wing in 1937, makes reference to some of the early introductions about 1882 to 1885. Collectors and private individuals also experimented with imported and locally made ploughs and other implements.

Perhaps the improved device which has been most widely adopted throughout India and which has more effectively than any other displaced the indigenous method is the iron roller sugarcane crusher. The exact history of the iron roller crusher seems shrouded in mystery. This is perhaps the most outstanding instance of an agricultural engineering improvement developed by manufacturers and dealers in India.

Aside from the cane crusher, the one other thing which seems to have spontaneously taken hold over a large part of the country is the small chaff-cutter. Originally imported from England, it has in recent years been manufactured in large numbers by a number of different firms, particularly in the Punjab, but elsewhere also. After a period of very poor machines, it appears that public demand is now stabilizing on a machine of reasonably good quality and competition between firms is keeping the price as low as is consistent with the quality demanded.

The Indian plough

Various people have in the past reviewed the development of ploughs in India. N. G. Charley in his paper in 1937 dealt with the history of the improved plough in India at some length.

Local factors favoured the adoption of cast iron ploughs in India, factors having nothing to do with the merits of cast iron for the purpose. The process of fabrication was simple. A little sand moistened with water could be shaped into the mould and used repeatedly. Cast iron in the form of new pig and in the form of scrap was more easily available than steel. With a pit furnace, little more than a hole in the ground, a hand-operated fan which could be and often was made locally, a supply of coke and a crucible which while imported was not very costly, a foundry could be set up. Foundry skill is relatively simple as compared with the working of steel. A few

months' working in an engineering workshop where casting was done was sufficient training for a moulder to start work. The amount of hard labour required was much less in the case of cast iron parts as compared with the making of steel parts by hand. The forming of steel by machines was only developing in the west and there and in India as much as possible of all machines was still made of cast iron. The advantage of cast iron was particularly great in the case of parts of complicated shape.

It was natural, therefore, perhaps all but inevitable under the conditions, that the Agricultural Departments should standardize on cast iron ploughs. In many cases, however, the cultivators refused to use the cast iron shares, having poor ones made of steel by their own blacksmiths when the Department failed to furnish steel ones as desired. It was natural that early manufacturers should look to the Agricultural Departments for help in getting sales and from this it was only a step to the Departments undertaking the sales directly through departmental agencies. To the Departments this appeared to have advantages; they were thus able to control types offered to the public according to their views of what the public should want; they were able to control prices, allowing the maker such profit as they thought fit and in some cases absorbing the cost of sales in the departmental accounts, making the price to the cultivators low indeed, but thereby cutting out the possibility of independent competition with them.

Private enterprise

In some parts of India, these conditions did not exist. Kirloskar Brothers, starting with the manufacture of a chaff-cutter, soon added ploughs, copies of models which had some measure of local acceptance if not popularity. They made arrangements for local stockists and for repair service and they pushed the sales as a business. As demand grew, they improved the quality and finish of their implements and added new models from time to time to meet additional needs. In contrast to this, I am convinced that the hold the Departments in other provinces have had on the trade in implements, coupled with the insistence on the sale of what I consider unsuitable types of ploughs, has resulted in not only not fostering the introduction of better implements but actually delaying such introduction. At least so far as North India conditions are concerned, designs distributed have often been faulty in that they only provided, often inadequately, for one part of a season or operation and did not fit in well into the whole series of operations necessary to produce a crop; material has often not been the best available, quality and workmanship have often been sacrificed to cheapness (low first cost has been made a veritable fetish in some cases, without regard to ultimate costs or to efficient working). In fairness to agricultural engineers, it should be stated that little of this condition is their fault.

Suggestions for the future

The first suggestion I would make for the future development of agricultural engineering in India is the urgent necessity for training agricultural engineers in India for Indian conditions.

In other lines of work we employ specialists trained for their job. It would be no more absurd to employ a chemist to do research in plant breeding than it is to employ a civil engineer trained to design and construct canals, roads and buildings, or a mechanical engineer trained in the operation of big power plant or in manufacturing methods to conduct research on improved implements or their application to agricultural practices. Doubtless sound scientific training in any subject is a help in mastering any other and it is also true that a soundly trained science graduate, given sufficient time, should be able to master after a fashion an unfamiliar branch of science, but the practice of employing specially trained men is too common to need more emphasis here.

A sound professional training in agricultural engineering should include three phases. First, it should include a sound basic training in agricultural principles, particularly the knowledge of chemistry, botany, soils and animal husbandry, necessary to understand the fundamentals of plant growth.

Secondly, it should include a sound training

in engineering fundamentals and processes. It should cover such subjects as manufacturing methods, particularly those applying to the manufacture of implements along modern lines, engineering drawing and structural design including special attention to design of agricultural buildings, a sound training in mechanics and statics, elementary training in electricity and its application particularly to motors and to distribution systems for rural electrification, and the application of engineering principles to the construction and operation of agricultural implements and machinery as engineering devices.

Thirdly, the training of agricultural engineers should include some intensive training in the application of engineering principles to agricultural problems. The practical application of engineering principles should be kept in mind at every stage. While the engineering training should be sound engineering, it should not be taught abstractly but as an applied science.

Some real difficulties

There are certain real factors in the situation of the cultivator which are very great difficulties in his way. While he may not be excessively conservative as an individual, it is true that religion and social custom are against change. Indian social life in general is built around group control and does not encourage innovations. The individual is not free to do as he pleases in many phases of his life. At least in North India, the zemindari system has often been a brake on progress, the zemindar tending to take in one way or another any benefit accruing from any innovation in crop or practice and quite generally discouraging innovations.

The mistake of failing to understand and utilize the *jajmani haq* system under which indigenous implements and tools are made and repaired, has been a deterrent to the introduction of better ploughs in many cases.

My first suggestion for the future is that a thorough study be made of the social customs, village organizations and economic factors which may affect the introduction of implements.

The second suggestion is that agricultural engineering research be on a more comprehensive scale than hitherto. We should not set out to develop a small soil inverting plough but rather to study the problem of seed bed preparation throughout the year.

My third suggestion is somewhat related to the above. We should give more attention to long-range objectives in planning our research programme for implements. Of course, we say that our objective in all our agricultural improvement work is to raise the standard of living of the cultivator. So far so good; but that is very general and not very definite. Some much more definite and immediate objective would be conducive to more definite results. Just as we should not too closely restrict our objective, we should not be too diffuse. Possibly in recent years we have been frightened by the spectre of unemployment and have been unwilling to face the real objective of the introduction of better implements, *the better utilization of human labour*.

In fact, the first generalized objective I would suggest would be the working out of such a combination of improved implements and cultural practices as would reduce the need for the large amount of casual seasonal farm labour now required, particularly the necessity of employing large numbers of women and children in field work.

Technical suggestions

First, I would point out that research should be directed toward developing implements which can be utilized on areas approximating those now available to the larger cultivators in each area.

Secondly, the power for working the implement is equally as important as the implement.

Certain problems needing investigation have been mentioned as illustrating principles or statements made. The following is a suggestive list of investigations which in my opinion need to be carried out, keeping in mind the principles laid down above. It is not meant that this list is exhaustive or complete but only suggestive.

1. The relation of improved inplements to soil fertility, particularly in relation to dry weather ploughing and to green manuring.

2. A full investigation of the problems of

fodder production and storage under village conditions, including particularly the possibility of making silage.

3. The problem of harvesting, both of *kharif* and *rabi* crops. Possibly next to weeding and interculture, the harvest is the operation which makes the biggest demand for seasonal labour.

4. Improved methods of threshing, winnowing and grain dressing should give a substantial increase in the income of the cultivator.

5. There is real need for a device for lifting water efficiently for small lifts.

6. The present persian wheel is a great improvement on the old wooden one with grass ropes and clay pots. For shallow depths, it works fairly well but in deeper wells wear on the chain is very severe. There is need for a better chain for carrying the buckets and possibly for better bearings. There is need for the investigation of the possibility of better gearing, arranged for separation from the chain wheel so that it can be used for other purposes.

7. Attention needs to be paid to the possibility of using bullock power for some of the power needs requiring rotary power.

8. A rich field for investigation lies in the whole subject of soil and water conservation.

9. Transportation of crops from field to farmstead and from farm to market in head loads is one of the very large wastes of agricultural labour.

10. What is the need and what is the possibility of farm fencing in India ?

11. While any extensive rebuilding may have to wait for some rise in the standard of income, it is not too early to begin survey studies of the building needs of the cultivators.

12. Agricultural engineers should take greater interest in developing equipment for the dairy industry, particularly for the use of the *gowalla* and small dairyman.

13. The making of new equipment available to the cultivator is equally as important as the designing and manufacture of it. Many things like smaller implements are suitable for individual ownership. Larger machines, more complicated machines requiring more training or skill for operation or requiring repairs outside the skill and facilities of the village blacksmith will in the beginning at least have to be made available otherwise. Agricultural engineers should study and where possible experiment with solutions to these problems.

MIXED CROPPING IN INDIA

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MIXED cropping is a common practice in tropical countries both with annual field crops and with perennial plants like fruit trees, flowering plants and plantation crops. This type of cropping prevails in Africa, India, Ceylon, Malaya and the West Indies. It is also usual to grow annual herbaceous crops in the midst of woody perennial trees of economic importance such as coconut, mango, *jak*, silk cotton and other trees.

Profitable method

In his survey of agricultural India (*India in 1887*), Wallace devoted a special chapter to rotations and mixed crops. He wrote: 'The growth of mixed crops is a widespread practice which is well worth consideration and study. The advantages under Indian conditions are distinctly great. There is but one explanation of the existence of these practices (mixed cropping), viz. that they have been found advantageous after long experience and much careful consideration on the part of a body of workers who, for power of observation and an intelligent interest in and knowledge of everyday occurrences would put to shame those classes which hold a corresponding position in educated Europe.' Voelcker, in his *Report on the Improvement of Indian Agriculture,* wrote: 'It is quite a mistake to suppose that rotation is not understood or appreciated in India. The contrary is the case. Frequently more than one crop at a time may be seen occupying the same ground, but one is very apt to forget that this is really an instance of rotation being followed. The next year the same mixed crops may be sown again and thus to the casual observer it might appear that continuous cropping was being practised. This, however, is not so, for there is a perfect rotation of cereal and legume. This is, perhaps, the simplest form of rotation, but there are many more complicated than that of mixed cropping. The simplest form is thus one in which individuals in cereal and pulse and other crops in the mixture get the fullest chance of exchanging their places with each other—a sort of rotation in a tabloid form in time and space.' Mollison, in his *Text Book of Indian Agriculture,* wrote: 'The system of mixed crops so common in India is undoubtedly a successful and profitable method which probably has done more to uphold the fertility of the Indian soils than any other practice. The successful practice of growing mixed crops in India points to the fact that the practical experience of the uneducated Indian ryot has determined centuries since, a means of providing an inexhaustible supply of nitrogen for the soil, whilst enlightened European agricultural chemists have only recently begun to see the way.'

In the 1905 *Proceedings of the Board of Agriculture in India*, Appendix C, dealing with the improvements in methods of cultivation in connection with the progress of agricultural experiments and programmes of work, the system of mixed cropping is characterized as 'most slovenly'. The verdict on mixed cropping thus swings between two extremes. No serious, systematic and sustained attempts have been made to understand the rationale of this long-existing practice. Even the Royal Commission on Agriculture, while devoting some attention to the problem of rotation of crops, makes no mention of this widely prevalent practice of mixed cropping. In the reports on the progress of the action taken on the recommendations of the Commission, Bombay and Madras touch on mixed cropping while dealing with the rotation of crops.

Use in rain-fed areas

The practice of mixed cropping in agriculture is more commonly adopted in the cultivation of lands which depend upon rainfall for water supply. Out of a total area of about 360 million acres under cultivation in India, in

more than 80 per cent crops are raised with the help of rain. The crops in these dry lands are mainly millets and partly pulses, oilseeds, fibre and other crops. Weather conditions are precarious and the problem of manuring is not easy. This vast extent of arable land has thus to be maintained on an efficient system of tillage and cropping. Mixed cropping is an ancient and widely prevalent practice and its importance is thus obvious.

Subject for speculation

While the full understanding of prevalent mixtures in the cropping of dry lands has not been examined critically, industrial crops like cotton, groundnut, tobacco, etc. began to figure very prominently in the agriculture of dry lands, and stimulated the need for a system of rotation and mixture with a view to ensuring the success of the expansion of the area of these industrial crops, while at the same time maintaining soil fertility and catering to the current economic needs of the cultivators. The result is that what little knowledge we have on mixed cropping is recent and with reference to problems arising mainly out of cotton and groundnut cultivation. The factors behind this ancient practice still remain subjects for guessing and speculation.

The Director of Agriculture, Mysore, states: 'I attribute the perennial poverty of the dry land cultivator in Mysore to his inability to earn money in addition to food and fodder out of his agriculture. The largest scope for increasing income per acre from dry farming and raising it from a means of bare livelihood to a lucrative industry lies in inter-cropping, or in the raising of two compatible crops from the same land in the same season so as to double the income from dry farming.' Inter-cropping of a cereal with a legume is common. Fresh areas have been thrown open to cultivation in the Irwin Canal area of Mysore. More cotton is required by the state. A successful method of inter-cropping cotton with the staple cereal *ragi* (*Nagli*) (*Eleusine coracana*) has been evolved and introduced. Similar problems are to be faced and solved in other parts of India.

Popular practice

Almost every field crop grown in India is often grown as a crop mixed with some other crop or crops in some part of the country or other. An idea of the various crop combinations commonly met with in some parts of India can be obtained by a reference to the *Imperial Gazetteer of India* and Mollison's *Text Book of Indian Agriculture.* A paper on crops grown mixed with sorghum was recently published in the February 1941 issue of the *Madras Agricultural Journal.*

Cereals grown in dry lands are usually grown mixed with many other crops which produce some article of everyday need to the cultivator. The nature and number of crops mixed differ in different areas. It is difficult to obtain information as to why certain crops are mixed in certain areas and in what proportions, and what are the definite advantages of growing such mixed crops. Economies in cultivation and land, provision for the domestic needs of the cultivator, a system of insurance against weather and pests, some vague idea of maintaining soil fertility, etc. are some of the observations with which this well-established practice has been dismissed without a rational analysis.

Attempts at experiments on mixed cropping have been made in various centres with the starting of many agricultural research stations. But in many of these the experiments do not appear to have been pursued long enough or well enough to draw useful conclusions. Experiments on mixed cropping have to be conducted for a series of years and at various centres so as to study the results in relation to soil and climatic variations. The intensity and complexity of the problem seems to have deterred a pursuit of it on sound foundations. Experiments on mixed cropping should be laid to begin with, only in such areas in which the system of mixed cropping is prevalent. The possibility of successful experimentation depends upon the nature of the soil and the seasonal conditions that will admit of suitable sowing facilities and growth periods for the crops forming the mixture.

Current combinations

What results are available in this line are summarized below in so far as they could be gathered from literature available in the Coimbatore library. They tend to emphasize

the need for a comprehensive record of existing practices and laying down suitable experiments on modern lines to elucidate the many problems confronting the mixing of crops, both old and new.

At Pusa, it was observed by Howard that there was a marked advantage in growing mixed crops of gram and wheat on soils where combined nitrogen is a limiting factor. Experiments at some stations in the United Provinces have shown that the local practice of sowing mixed wheat and gram on irrigable black soils is less profitable than sowing wheat and gram in rotation. But in spite of this there appears to be a preference for growing the two crops mixed, for the report says that 'the practice of mixed cropping, however, will probably take a long time to die out'. Though it is a common practice to grow sorghum and other millets along with a number of other crops, experiments conducted at various agricultural stations have not led to any definite results with regard to the suitability of any particular subsidiary crop or the benefits derived by growing such mixtures. At the Cotton Breeding Station, Coimbatore, various pulses were grown in combination with sorghum and it was observed that the mixing of pulses with sorghum does not benefit either the sorghum or the succeeding crop of cotton. The pulse reduced the straw yield of sorghum. At Nandyal, *pilli-pesara* (*Phaseolus trilobus*) when grown as a mixture with sorghum had a depressing effect on the yield of sorghum. At Guntur, *pilli-pesara* was grown mixed with sorghum for fodder. There was no increase in yield by growing the mixture. But this mixture is common in the area, as the mixed fodder obtained is believed to have a higher nutritive value due to the legume in the mixture.

At Koilpatti (Madras), the effect of pulses in combination with sorghum on the succeeding cotton crop was tried, and it was observed that this mixed cropping did not reduce the harmful after effects of sorghum. In a rotation experiment conducted at the Poona Agricultural College Farm, it was observed that *bajri-tur* (*Cajanus*) mixture grown every year gave the highest return over other rotations. At Koilpatti, it was observed that *cumbu* (*Pennisetum typhoideum*) when grown mixed with red gram, lablab, or Bengal gram, yielded as good as and sometimes better than the cereal grown as a pure crop, if the crop was sown early. If, however, the sowing was delayed, it was advantageous to grow the *cumbu* as a pure crop. At the Gokak Farm in the Bombay Presidency, a mixed crop of maize and *tur* in rows gave decidedly better results than growing two crops of maize one after another, and it is reported that this practice has been adopted by many cultivators. More recent experiments indicated that a mixture of maize and cotton is more profitable than maize and *tur* mixture, as *tur* is sometimes liable to the attack of wilt and consequent reduction in yield. In rotation experiments at Pusa, the highest gain in soil nitrogen was in one series with a mixed crop of maize and *urid* (*Phaseolus radiatus*). The mixed crops gave the highest economic returns.

Experiments with cotton

With regard to cotton, experiments were conducted with various crops which could be grown as mixtures with it at the agricultural stations in the cotton-growing areas. At the Guntur Agricultural Station a mixed crop of cotton and groundnut proved to be the best when compared with cotton and Italian millet, cotton and rice (rain-fed) and cotton alone. At the Nandyal Agricultural Station, a mixture of cotton and horsegram (*Dolichos biflorus*) gave yields similar to cotton grown alone, and the residual effect of horsegram in the mixed crop was non-existent or negligible. The only advantage was the produce from the horsegram grown in the mixed crop. At the Hagari Agricultural Station, a mixed crop of cotton and Italian millet was compared with a pure crop of cotton, and it was observed that there was no difference when the money value of the total produce was considered; but the yield of cotton was lower in the mixture than in the pure cotton plot. This combination was later observed to be ecologically not good as there was severe competition between the underground parts in these two crops as both feed in the same zone, and the quick-growing *Setaria* depletes the soil moisture quickly and thereby cotton suffers. At the Koilpatti Agricultural Station, Bengal gram (*Cicer*

arietinum), horsegram and coriander (*Coriandrum sativum*) were grown mixed with cotton and compared with cotton grown alone. The monetary return of the mixtures was less than that of cotton alone. It was, however, found that a low proportion of coriander does not affect the cotton yields and is a sound combination, as the produce of coriander from such a mixed crop is an extra gain. Various other pulses which were tried along with cotton led to no definite conclusions. At the Central Farm, Coimbatore, mixed crops of cotton were tried and it was observed that mixed crops with cotton are not financially profitable as the price of cotton was at the time very high. The price factor will naturally fluctuate. In the Bombay Presidency, experiments at the Gokak Farm showed that a mixed crop of cotton and *rala* (*Setaria italica*) was better than growing cotton alone, an experience contrary to that at Hagari. At the Dharwar Farm it was observed that cotton and groundnut in alternate rows gave better results than cotton and groundnut in blocks. In after effects also the succeeding crop of sorghum gave higher yield in the plots of cotton and groundnut in alteranate rows, than cotton and groundnut in blocks taken together.

Experiments in strip cultivation are in progress at the Dry Farming Station, Bellary. Groundnut is an introduced crop and in certain areas it has replaced not only other commercial crops but also food and fodder crops. With the increase in area, and also due to the incidence of diseases and pests, the crop did not prove quite remunerative after a period and so the growing of cereals alone or in combination with it was resorted to. To study whether a mixed crop of cereal-groundnut, or a rotation of a cereal and groundnut in alternate years was more profitable, experiments were conducted at the Palur Agricultural Station. In this mixed cropping the cereal is sown first and the groundnut is interplanted a month later. The results over a number of years lead to the conclusion that mixed cropping of cereal and groundnut is better than rotation, and *cumbu* is the best cereal to grow as a mixture. Experiments with millets, pulses and castor in combination with groundnut are in progress at the Tindivanam Agricultural Station. Results so far obtained show that the best total returns were obtained by growing groundnut in association with sorghum, castor, red gram, or cotton. But in all cases mixed cropping resulted in the depression of the yield of groundnut. It has been reported to be very profitable to grow groundnut between rows of *arhar* (*Cajanus cajan*) in the United Provinces.

Insurance against failure

Among the various reasons why some crops are often grown as mixtures, the most important appears to be to guard against the risk of a total failure of harvest in an unfavourable year ; but there are no long-range experiments to prove this. The average holding of the Indian cultivator is small. To ensure that he obtains some produce or other from the limited land he has, he grows a mixture of crops so that even in years of deficient rainfall he is able to secure some produce for his household needs. On the other hand, if the season is favourable he may harvest a plentiful crop. Experiments in Greece indicate that the yields of the mixtures were much less variable than those of single crops, this being attributed to an automatic adjustment of the crop to the meteorological and edaphic conditions. It is a common practice in some parts to grow even different millets like sorghum, *cumbu* and *tenai* (*Setaria italica*) besides pulse and oilseed crops, all together in the same plot of land. Moreover, the ryot with limited land is not in a position to grow different crops separately ; he presumably resorts to mixed cropping to obtain most of his personal needs from the bit of land he has. There is a saving not only in land but in labour. Usually the average ryot does not engage outside labour but cultivates his land with the help of the members of his family. As different crops come to harvest at different times, the limited labour is utilized to the fullest advantage in the harvesting and preparation of the produce of different crops. These aspects need scrutiny from an economist's point of view.

It is recorded that the process of nitrification in soils is much more active when a growing crop is on the ground than when the land is left fallow. Sometimes a long and short duration crop such as sorghum and *Setaria*

or sorghum and red gram are grown mixed to get the maximum outturn from the land. The short duration crop is harvested first and the other continues in the field, and if the season is favourable yields almost as much as a pure crop. What are known as catch crops also come under this category. Maize, pulses, onions, melons, vegetables, etc. are grown in sugarcane fields when the cane crop is young. Similarly, such crops are also grown in gardens among fruit trees when the latter are young.

Symbiotic activity

Various pulses are cultivated in India and most of them are usually grown as mixtures among the cereals or other crops of commercial value. This is considered to be a sound agricultural practice as the legumes help by their symbiotic activity to keep up the supply of combined nitrogen in the soil and maintain soil fertility. It has been recorded by Loehwing that under American conditions natural processes of fixation restore on the average about 60 lb. of nitrogen per acre per year under legumes and 10 lb. under non-legumes. Not all leguminous crops increase the nitrogen content of the soil; Howard has recorded that Java indigo seriously depletes the supply of combined nitrogen in the soil. Intercropped legumes are said to increase also the available lime, potash and phosphoros in the soil by their greater solvent action and the ability of their deeper root system to raise these nutrients to the surface layers. This probably explains how the Indian ryot is able to grow mixed crops year after year on the same land without the addition of manure.

A legume grown mixed with a cereal increases the fodder value of the latter. It is also reported that the protein content of the cereal grown in combination with a pulse is increased thereby. This has been recorded to be obtained in pastures where legumes are grown in combination with grasses. This system of growing legumes in combination with other crops is being now followed in the maintenance of pastures and in the cultivation of silage crops in Europe and America. The full implications of this combination in the case of regular field crops have to be investigated; the more so, as the only means of toning up quality.

E

By growing together crops with differences in root habits, the plant food and moisture in the soil is utilized to the best advantage. As their roots feed at different depths in the soil there is no competition for plant food or moisture. Root studies at the Dry Farming Station, Bellary, have shown that *Setaria*-groundnut, and *Setaria*-horsegram mixtures are ecologically sound combinations; but *Setaria*-cotton mixture is not sound, as there is severe root competition between the two components of the mixture, both feeding in the same zone. Such root studies should be made on a more comprehensive basis and extended to all crop combinations. The combination of a shallow and deep-rooted crop is reported to improve soil tilth and texture also.

Check on erosion

Soil erosion studies at the Dry Farming Station, Bellary, have shown that *Phaseolus aconitifolius*, groundnut, horsegram and mixtures of groundnut and horsegram with *Setaria* are comparatively more efficient in preventing soil erosion. Trailing crops like *Phaseolus aconitifolius* or horsegram grown mixed with cotton or sorghum, which are usually widely spaced, help to prevent the erosion. This aspect merits a more comprehensive examination.

Some components of mixtures afford protection to weaker crops. Pigeon pea is usually grown as a subordinate crop with cotton in the Punjab, where it is considered to protect the cotton from the desiccating effects of the hot winds. Sorghum and *bajra* when grown mixed with *mung* (*Phaseolus radiatus*), afford shade to the latter. The stalks of sorghum serve as supports to lablab and cowpea usually grown mixed with it. Stray plants of sorghum in a field of other crops act as a check on cattle being allowed to trespass and graze on the young crop, as sorghum plants in the young stages are poisonous to cattle. Border crops of linseed in wheat fields are said to keep off cattle; so also safflower round sorghum fields. *Sesbania acculeata*, red gram, hemp (*Hibiscus cannabinus*), castor, etc. are grown on the borders of sugarcane fields to serve as protection to sugarcane.

Some crops may be grown as trap crops for

insects or animals. Sorghum or maize may serve as useful trap crops for stem-borers of sugarcane. Damage due to insects and diseases is sometimes lessened by growing mixed crops. The disease or insect does not spread so quickly as when pure crops are grown. It has been recorded in the Punjab that mortality in cotton due to root-rot disease was reduced considerably by growing cotton and sorghum mixed. A mixture of *moth* (*Phaseolus aconitifolius*) also reduced mortality of cotton due to root-rot.

It is not economic to grow some crops like green gram (*Phaseolus mungo*) or cucumber (a field variety) as pure crops ; they are therefore always grown as mixtures. In pastures, a mixture of grasses is considered to be more advantageous as the mixed hay obtained gives a variety of feed and a better balanced one than a single kind. Legumes in pastures are considered to act as a check to the growth of weeds.

More research needed

The above review shows the need for a thorough examination of this important agricultural practice of mixed cropping. A full record of all existing practices throughout India should be made and examined. Such experimental work as has been done in this line in the various provinces should be brought together for scrutiny. The agronomic and economic backgrounds of these practices should be investigated through suitable long-range experiments and improvements on them suggested. The introduction and expansion of the area under commercial crops necessitate the designing of suitable mixtures with a view to conserving soil moisture and fertility, and ensuring the production of the cultivators' personal needs. In 1937, Sir John Russell, in his Report on the work of the Imperial Council of Agricultural Research, stated : 'The agricultural economic aspects of mixed cropping should be studied in view of the widespread use of this practice and the probability that some crops mix better than others.' The initiation of a comprehensive enquiry and the laying down of suitable experiments in this line are necessary in the interests of the cultivators of the vast rain-fed areas in India. The Board of Agriculture at its recent meeting has realized the importance of this subject and necessary steps are being taken to gather data and initiate comprehensive research on the problem.

DEGENERATION OF IMPROVED CROPS IN INDIA

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When an improved variety of an agricultural crop is released for general distribution among cultivators by the Agricultural Department, sooner or later a report generally follows that the improved variety has deteriorated or degenerated. Farmers, dealers and commercial seed growers complain that the acre-yield of the improved variety has gradually decreased or that the variety has deteriorated in quality, a few years after its introduction. As the cultivator's return ultimately depends upon the quantity and the quality of the crop he grows, it is of paramount importance to consider the various causes that may lead to the degeneration of an improved variety and to find out such measures as can be practised by the cultivator and the plant breeder to reduce it.

Causes of deterioration

It is well known that the behaviour of an improved variety or in fact of any variety is the function of the genetic constitution it inherits and the particular environment in which it grows. A change in either of these may result in deterioration. Thus the causes of deterioration may broadly be classified into genetic and non-genetic. The latter will be considered first.

When an improved variety is given out for distribution, it comes to be grown on areas, and under conditions which are different from those where the variety was bred. If its cultivation is extended to areas not particularly suited to its growing, then naturally it will not grow or yield so well as formerly. Unsuitable soil conditions and unfavourable climatic conditions such as rainfall and length of day may profoundly influence the general performance of a variety. An interesting case of deterioration in quality of wheat grain was reported from Bengal a few years ago when two samples of wheat of the same variety were supplied by a correspondent to the Agricultural Commissioner. One sample grown in the Punjab showed well-filled hard grains, while the other sample which had been grown in Bengal from the same original seed consisted of shrivelled grains, of rather uneven texture, and was considered to have deteriorated. When these two lots of seeds were sown at the Imperial Agricultural Research Institute at New Delhi it was found that they gave rise to plants which did not differ in any observable characters. The deterioration observed when this wheat was grown in Bengal was therefore the result of growing it under very different soil and climatic conditions from those obtaining in its original home. It is the general experience that wheats grown under *barani* (rain-fed) conditions usually yield harder and more lustrous grains than those grown under conditions of irrigation even when the same varieties are used. An apparently detrimental influence of environment on the quality and the quantity of an improved variety may thus give rise to the cry of deterioration.

In crops like cotton the question of quality is specially important and it is known that the fibre qualities of this plant may be altered as a result of changes in environment. A cotton strain which spins up to 40 counts when grown in Madras under irrigated conditions hardly spins 30 counts when grown as a rain-fed crop in central India. Unsuitable soil conditions also lead to a decrease in acre-yield. An improved variety, due to its high-yielding capacity, may remove comparatively a greater amount of fertility from the soil than the original poor-yielding one. Its continuous cultivation, without proper rotation, may result in the exhaustion of the soil, and the subsequent yields, therefore, are much less than the previous records. This may be another of the reasons for the general complaint that recommended varieties deteriorate. Agricultural Departments with the aid of the plant breeder should as far as possible prescribe

definite tracts for improved varieties. The evils of deterioration due to unsuitable environmental conditions will then decrease to a substantial degree. The cultivator should as far as it lies in his power take adequate measures to replenish the soil so that the acre-yield will not fall due to poor soil conditions.

Attack by diseases

Sometimes an improved variety is considered to have deteriorated because it is affected by diseases to which it was supposed to be resistant during its creation or in the early days of its expansion. The causes of such deterioration are obvious. Certain improved varieties are not affected by diseases in a particular locality. In some cases they are free from the disease, not because they are resistant to it, but because the causal organism responsible for the disease is absent. When such a variety is extended to an area where the causal organism is prevalent, the variety naturally falls a victim to it. The problem of disease resistance is further complicated by the fact that the causal organism, for example the fungus causing the rust disease of wheat, consists of different varieties which are recognized by plant pathologists as physiologic races. A particular wheat may not be affected by one physiologic race, but it may be highly susceptible to another. For instance, a popular variety of wheat of the Bombay Presidency, Bansipalli 808, is resistant to two out of the six forms of black stem-rust. It is attacked heavily in the southern parts of Bombay, but it generally escapes rust in the Deccan. The so-called deterioration will, therefore, in such cases, depend upon the distribution and seasonal incidence of these physiologic races. A particular variety may appear to be resistant to a disease, simply because it escapes the disease by ripening at a time when the environmental conditions are not suitable for the vigorous growth of the fungus. It is reported that IP4 wheat, being early, escapes rust attack in Bombay. If on the other hand the variety ripens some time after the appearance of the fungus, heavy infection is the outcome. It is desirable that the plant breeder should test his varieties for resistance under optimum conditions of infection to disease before releasing them for general distribution. Thus in Bombay, Jarila and Jaywant, two improved varieties of cotton, were supposed to be resistant, but succumbed entirely under optimum conditions of infection. The Sharbati wheats of the Central Provinces, A112, A113 and A115 evolved from a cross between a common wheat and *Khapli* wheat were thought to be resistant to stem-rust, but later on were found to break down in their resistance. But the resistant parent (*Khapli*) concerned in the breeding of these wheats has been shown by later work to be not resistant to all the races of rust occurring in India. It must be pointed out, moreover, that at the time these were brought out, there was no accurate information regarding the physiologic races of the rust prevalent in the province.

Mixture with poorer types

Another potent cause of the deterioration of an improved variety is its mechanical admixture with poorer types. Proximity of threshing grounds, the use of the same yards, contaminated drills and seed-bins often cause extensive mixtures. In cotton, seeds may be mixed up in ginning factories. If the mixture of two or more varieties is perpetuated, a poorer type, due to its better adaptability to environment, may dominate the improved variety which will then be considered as having deteriorated. Since it is extremely difficult to prevent mechanical mixtures altogether, the best that can be done is to minimize the extent of contamination. The importance of thorough rogueing of the off-types is too obvious to need any emphasis. Extensive propaganda should be carried on regarding the advantages of rogueing, so that farmers may come to consider this operation as a normal routine in the cultivation of improved varieties of crops.

An improved variety may undergo degeneration if a change takes place in its genetic constitution. It is generally supposed that an improved variety released for distribution is pure, i.e. it breeds true to its type. When two varieties of a crop are crossed together with a view to evolving a better type, the progeny of the first few generations exhibit a wide range of variability in their characters.

The plant breeder selects plants which possess the combinations of attributes he desires, in each generation, till his selected plants appear to be breeding true. They are then said to be pure. But recent advances in the science of genetics reveal that such strains are pure only for the more obvious characters and there may still exist variability in respect of physiological and other characters. Naturally, therefore, the variety will still manifest a range of genetic variability, though on a limited scale. In a few years new types would arise, among which would be a few obviously different from the bulk. These rogues, if unnoticed, will multiply and the improved variety will appear to have deteriorated. In order to check this evil, the plant breeder should assure himself that genetic variability is reduced to a reasonably low level before he certifies a new variety for general release. Secondly, the Agricultural Department must have stations responsible for maintaining genuine and pure seeds of the improved varieties. At these stations suitable systems for maintaining purity must be adopted and secondary selection carried out as found necessary. The new strain of cotton, Jarila, in Bombay is an example of secondary selection from an improved strain Verum 262 from the Central Provinces.

Natural crossing

The phenomenon known as natural crossing is one of the most important sources of deterioration in improved varieties. Although many of our important crops like rice, wheat and cotton are self-fertilized, they are liable to cross-pollination also. If different varieties of the same crop are grown in the vicinity of one another, as generally is the case in the cultivator's fields, there is every chance of the better variety being crossed with an inferior one. The segregating progeny of such a cross will naturally contaminate the population of the improved variety. Rogueing of the off-types can be suggested as the best control measure for reducing the extent of deterioration due to natural cross-pollination. In this connection, the problem of deterioration among naturally cross-fertilized crops may briefly be considered. Crops such as the oil-yielding *Brassicae*, maize, and *bajra* are normally cross-fertilized. Some of them are almost totally self-sterile, while in others a reduction in vigour occurs if self-pollination is compulsorily enforced. In such plants single plant selection is impossible, and pure seed is raised by selecting a limited number of plants as closely alike as can be found and growing them in isolation. In the case of these plants, the maintenance of uniform strains is a matter of difficulty and the possibilities for rapid deterioration of a cross-fertilized crop are very great.

Then there is the case of the vegetatively propagated crops such as potatoes and sugarcane. Degeneration has been traced in these crops to be the cumulative effects of virus diseases which are handed on with the tubers, setts, etc. in the process of vegetative propagation. The damage thus caused can be extremely severe and the importance of using disease-free planting material cannot be over-emphasized.

The hereditary constitution of a plant may be altered by sudden changes known as ' mutations '. Sometimes these changes are so minute that they may escape detection, but an accumulation of such inferior mutations may lead to deterioration of an improved variety.

Essential precautions

From the foregoing account it will be clear that so-called deterioration may result from a number of causes. Although the cultivator can preclude the possibilities of deterioration to a considerable extent by taking care to keep his seed pure and by maintaining the fertility of the soil, the plant breeder and the Agricultural Department can also help. The latter should recommend suitable varieties for definite tracts, so that deterioration due to unfavourable environmental conditions will be avoided. Extensive propaganda is needed to impress upon the mind of the cultivator the importance of rogueing off-types before harvesting the crop. The Department should also undertake seed supply schemes, as is being done in cotton by the Indian Central Cotton Committee, so that the cultivator may get pure seed at a reasonably cheap rate. In this connection it may be mentioned that most of the agricul-

turally advanced countries have got seed legislation in force preventing cultivators from growing anything but certified pure seed. As seed supply arrangements make progress such seed legislation may be required in this country also. The breeder must take all precautions to keep his strains absolutely pure so as to be able to supply pure seeds, true to variety, which can serve as 'foundation stocks' for multiplication. Systematic experiments must be laid out to find out how many generations from the breeding plot an improved variety can maintain its character in the cultivator's fields without undergoing any substantial deterioration, so that the cultivator may be advised to renew his stock of pure seed accordingly.

Finally, it can be concluded that degeneration or deterioration of improved varieties is not inevitable if suitable precautions are taken. If this is done, then and only then, the cultivator will be able to derive the full benefit from the plant breeder's work.

PROBLEMS OF SEED SUPPLY

By D. R. Sethi, I.A.S.
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Of all the achievements of the Department of Agriculture during the last three decades, the one dealing with the production and distribution of improved seeds of crop plants to the cultivator is the most spectacular and the one that has been readily adopted in farming routine all over the country. The general poverty of the cultivator has stood against his adopting other improvements on a large scale and till this lasts, seed must continue to receive the greatest attention at the hands of both the Department and the cultivators.

Supply of improved seed is a necessary sequence of successful crop research. This is the final stage in which the tiller of the soil is directly interested. Yet the present organization of seed supply is both inadequate and ineffective to reach every cultivator. Even where it does reach, its value is soon largely diminished due to deterioration of the seed as a result of continued cultivation and careless handling. In fact, the Departments face the question of the deterioration of seed within a few years of its introduction and very often much earlier than the variety has had time to spread fully. The general trend of complaint is lack of good germination, susceptibility to pests and diseases and ultimately low yield and quality. Such complaints when they appear earlier than the full spread of a variety undermine seriously the prospects of further expansion.

Causes of seed deterioration

Available evidence shows that this decline in yield and quality potential is due to the improved seed gradually becoming a mixture, lack of proper methods of cultivation resulting in loss of vitality and consequent susceptibility to pests and diseases and absence of proper methods of storage thereby impairing the efficiency of germination. The first cause is really due to the absence of any serious attempt on the part of the cultivator to keep his seed pure. No amount of propaganda will induce him to take the extra care that is necessary in sowing, harvesting and rogueing the plants that are not true to type. And in a few cases, where due care is taken, the improvidence or poverty of the cultivator often leads to his not retaining even a portion of the produce for his future sowings and he must therefore depend upon fresh supplies. The only solution seems to lie in constantly replacing this seed by approved seeds grown by the Department or other seed organizations controlled by it that are an essential link between the plant breeder at one end and the cultivator at the other.

Principal considerations

Two principal considerations in this respect are (i) the creation of a large number of seed farms and other organizations to produce large quantities of seed and their location within easy reach of the cultivator, and (ii) the method by which the cultivator can be made to come to the seed depots every year. The first calls for an effort on the part of the Department by way of additional seed farms which may not necessarily be owned by the Government and may be entirely private enterprise encouraged, advised and supervised by the Department at convenient distances, and creation of a body of seedsmen (or seed supply societies) possibly in every village, who would be licensed and equipped with proper storage arrangements. They would maintain rigorous standards of purity and germination and would be encouraged and given every facility to develop the seed business on sound lines, any unscrupulous attempt at selling mixtures or non-genuine seed would be severely dealt with so that in course of time a body of seedsmen whose antecedents and attributes are fully known is created. With proper planning it would be possible to so co-ordinate the various stages of seed supply,

namely (*a*) breeders' primary plot, (*b*) self-fertilized seed grown on a large scale and kept free from contamination, (*c*) registered growers who guarantee strict compliance with instructions and timely rogueing and (*d*) seedsmen or seed supply societies responsible for ultimate distribution of seed and valuable information bearing on the suitability of an ecotype to varying environmental conditions, its freedom from and resistance to pests and diseases and quality. And this is important if real seed supply service is the aim.

Cotton seed distribution

The present system of seed supply has its own limitations. Cotton has probably the best organized system in the country where under the financial assistance of the Indian Central Cotton Committee, the growers, the cooperative societies and a comparatively large number of seed farms, both departmental and private, play an important part, assisted by a fairly comprehensive cotton control Act. Its one outstanding feature is that seed distribution is strictly on a regional basis and only types that have definitely established their superiority to existing ones in different regions are multiplied and distributed. This work, however, requires further intensification so that strict 'type-belts' can be established to obviate any mixing in local ginneries or even in the *mandis*. Other crops receive varying attention according to their importance in the locality. In the main the organization consists of (*a*) departmental farms which serve as nuclei for improved seeds, (*b*) registered growers who multiply the original stock under instructions from and supervision of the Department of Agriculture, and (*c*) seed agencies serving as depots for supply to the cultivators. One point that needs copying from cotton seed organization is the regional basis of distribution of crop varieties. Obviously, there is need for immediate action in creating an effective organization for seed distribution.

Profit motive

As regards the second consideration, and this particularly applies to crops that cross freely and where consequently the deterioration is more rapid and the need for replacement more urgent, unless there is some monetary inducement, the cultivator will not be attracted by the idea of renewing his seed every year. A workable arrangement may be found in what follows : the cultivator brings to the seed depot after harvest a quantity of seed equivalent to his requirements for sowing in the next season. Against this he gets a receipt for claiming the seed at the time of sowing. This seed can be tested for its germination and purity and can be stored along with other tested seed or rejected to be sold as grain. Some precaution is, of course, necessary to ensure that the cultivator does not bring the worst portion of his produce. In order that the cultivator can take advantage of this method, some monetary inducement will have to be provided. The details of this inducement will depend upon a number of considerations, but 5 per cent of the value of seed to be given may suffice in the beginning. This will, however, require safeguarding against the cultivator using this seed for purposes other than raising new crop. Other arrangements where cash sales are a necessity may consist in giving to the cultivator interest-free loans repayable in easy instalments, the main consideration being that all such obstacles in the way of adoption of improved seed by the cultivator as can be resolved within the financial resources of the Department are removed.

With regard to the second cause of deterioration, viz. lack of proper cultivation and its resultant ill effects, intensive propaganda is necessary to popularize the seed nurseries which cater to the exclusive growing of the seed on good land specially prepared and manured. In view of the compact nature and smallness of nursery area, close supervision is possible and means whereby the crop is protected against pests and diseases can be adopted. Much evidence is now on record to show that properly farmed nursery seed is able to withstand adverse conditions of growth and resist pests and diseases better than the general seed and that it results in larger crops. In sugarcane an average of 60 per cent extra yield has been obtained and the quality has been decidedly superior.

Cultivators indifference

The third cause, viz. the indifference of the cultivator in matters of seed storage and preservation is another obstacle to the realization of high productivity from improved seed. It is essential that steps are taken to improve the technique and method of seed storage to ensure high germinability of seed. And closely connected with storage is the arrangement for treating such seed to eliminate insect pests and fungus diseases borne by seed. Thus hot water treatment for loose smut of wheat, copper carbonate treatment for bunt and flag smut and carbon bisulphide fumigation against weevils may prove extremely useful in eliminating these troubles in the next crop. The difficulty in their adoption, however, is that excepting the hot water treatment other measures can only be adopted in a big seed store under expert supervision. They are done at a time when they are most effective, viz. either at the time of harvest or just before sowing, depending upon the nature of the seed. It is the timeliness of the operation and its strict observance that can really help to get over the trouble in the next crop.

While in crops where self-fertilization is the general rule it may be easy enough to keep up purity with a little serious effort, those which cross freely render the task difficult unless strict regional distributions of varieties are possible and all interests, namely the cultivator, the commission agent, the seedsmen, etc. fully cooperate to work to that end. In vegetatively propagated crops, where there is no great chance of any serious admixture, the vigour of the home-grown seed is a matter for consideration and where this does not ensure the same standard of yield and quality as imported seed does, it needs constant replacement from outside. In horticultural seeds the chief consideration is the purity and quality of the original stock as a long time must elapse before these can be tested out in the field. This calls for an intensive survey of the existing orchards on the part of the Departments concerned to gauge their suitability to serve as stock for propagation and supply of grafts, etc. Constant vigilance is required during the actual operations of stock raising. As in the case of seedsmen, the nurserymen should also be licensed and any attempt to supply other than genuine plants severely dealt with.

Rigorous seed test

One further weakness in the present seed supply system seems to be that while purity or trueness of the seed is to a certain extent catered to, its quality does not receive the attention it deserves, notwithstanding the fact that environmental conditions, particularly seasonal abnormalities, materially affect the seed value. Rigorous seed testing to show the value of seed for planting is necessary and much work is needed to correlate laboratory germinability with field performance of the seed. Vigour of germination plays a significant role and may mean, under certain circumstances, the difference between a complete failure of a crop and its success.

Very often a variety or varieties are declared universal without sufficient testing under all types of season, soil and culture. The result is that deterioration under unfavourable conditions of growth sets in early and the period of usefulness of the improved variety is restricted. As an instance, the recent deterioration of cane crop in the white sugar belt is due largely to the extension of this crop to lands that were not suited to its growth and lack of application of principles on which cane farming had to be conducted. Similarly, in Malvi cottons the deterioration was due to considerable expansion of the area and the growing of cotton in unsuitable lands and not to mixtures as was believed for a long time*. The adaptation phase of an improved seed is important and the need for regular crop census and study of performance of new varieties under different conditions of growth obvious.

Diseases and pests

Linked with this is the question of disease and pest resistance of newly introduced types. This must be tested thoroughly long before the saturation stage in varietal introduction is reached. A variety that is resistant at one place may not necessarily be so under another environment or else it may be more prone to

* Hutchinson and Ghose, *Indian Journal of Agricultural Science*, 1937, Vol VII, p. 1.

another trouble which although it may be almost absent in one area, may be a serious problem in another. An embarrassing situation may arise where due to lack of appreciation of this aspect a variety is allowed to spread and it ultimately suffers at the hands of one or other of the diseases. Gram-blight resistant varieties given out on a large scale are reported to have altogether failed where wilt trouble was pronounced and it became necessary to compensate the growers for the loss of their crop. Apart from this financial loss, the setback to the confidence reposed by the cultivator in the departmental seed is likely to be great and such setbacks take a long time to recover. In this connection seed importations from one locality to another are also important and there are cases where such large-scale seed movements have definitely deteriorated the original stock due to the spread of new diseases not already important in the tract. This has been particularly noticeable in the case of vegetatively propagated crops.

One other aspect of seed supply that does not receive adequate attention but which is so closely bound up with the high productivity and longer life of usefulness of an improved type is the question of proper cultivation afforded to the crop. Improved seed necessarily requires more effective tillage and manuring for the fullest expression of its potentialities, else it must suffer deterioration. The present position is that while crop breeders have gone on producing new types, the cultivator has not derived the fullest benefit from even those types that were given out before, simply because the means to recover the best in a variety were not forthcoming.

This aspect has a direct bearing on seed supply because a poorly farmed crop does invariably fall prey to a host of pests and diseases and thus contaminates the whole environment, making it increasingly unsuitable for the proper growth of the crop concerned.

Seed and cultivation

To sum up, what is wanted to ensure purity, high germinability and freedom from disease of agricultural seeds is the elaboration of organizations that deal with the bulk multiplication of seeds of improved varieties raised by crop specialists through seed farms, guarantee or registered growers, cooperative societies or even private individuals with proper education and outlook and adequate means to carry the improved seed thus raised to each cultivator or group of cultivators through seed stores, seed agencies, seedsmen or seed supply societies with proper storage arrangements. The chief consideration here is that in course of time a body whose honesty is above dispute is created. Licensing of seedsmen is, therefore, essential and the need for maintaining rigorous standards of purity and germinability obvious. For quality of seed the development of nurseries devoted exclusively to seed production is envisaged. Need for suitable arrangements which will enable the cultivator to make use of seed depots for renewal and replacement of his home-grown seed has been pointed out. Emphasis has also been laid on the necessity for selection of seeds being made after thorough testing in different environments and the association throughout the phases of multiplication and large-scale cultivation of new varieties, of experts to gauge true values of adaptation through crop census. Similarly, the need for testing new varieties for resistance to all major diseases before large-scale introduction in a tract has been stressed. And, finally, the mutual interdependence of improved seed and improved cultivation for high productivity is of the utmost importance in achieving the best performance.

LEGISLATION AGAINST PLANT PESTS AND DISEASES

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INSECT pests, fungoid diseases and weeds add to the cost and difficulties of crop production. They are carried from country to country and locality to locality on nursery stock, ornamental plants, bulbs, tubers, roots, cuttings, seeds, fruits and vegetables. Insect pests and fungoid diseases legislation, therefore, aims both at the prevention of the establishment of undesirable aliens and at the eradication and control of indigenous and exotic pests and diseases. In ancient times injurious insects used to be prosecuted in law courts like common felons and when their guilt was established they used to be 'expelled or exterminated by sacerdotal conjuring and cursing'. Even honey-bees, which were normally held in high esteem for their industry, social organization and honey production, were punished for their misdeeds against man. For example, in 864* the Council of Worms decided that the honey-bees which had stung a man to death should be, and they actually were, suffocated in their hives.

Insects and fungi have, by their dark, perfidious deeds, forfeited their claim to legal advocacy and protection. To quote only one instance: loose smut, rust diseases and insect pests are destroying wheat to the extent of six crores of rupees annually in India. Therefore they have been condemned at the bar of human justice for all time as pests and contemptible felons and laws have been enacted to prohibit their entry into a country and to eradicate and control them. The *Phylloxera* pest of vine was the first insect against which such a law was enacted in November, 1881, by about 12 European countries simultaneously. Germany placed an embargo on the importation of all American fruits and fruit products in 1898 to keep out the notorious San José scale. This action of Germany gave the lead to insect legislation as a whole, for in subsequent years many countries erected legislative barriers against insects and diseases. In a number of countries San José scale was the insect to scare legislators into passing laws aimed at its exclusion or control, but in our country the Mexican cotton boll-weevil claims this distinction: a regulatory order aimed at ensuring its exclusion from India was passed in 1906 under the Sea Customs Act of 1878. This order was the precursor of our present Destructive Insects and Pests Act No. II which came into existence on 3 February 1914 as a result of representations from the Bombay Chamber of Commerce.

Indian legislation

Indian legislation embodies two lines of defence against insect pests and fungoid diseases: the first line of defence contained in the Act aims at preventing the entry of foreign insect invaders into India and their spread, and the second line of defence (in accordance with section 80-A of the Government of India Act of 1919) aims at the eradication and control of these as well as of local pests in the provinces.

In pursuance of the first aim such articles as Mexican jumping beans (*Sebastiania palmeri*), unginned cotton and sugarcane from Fiji, New Guinea, Australia or the Phillippine Islands are totally prohibited from entering India, while plants in general, barring a few exceptions, can be imported only by sea, provided they are accompanied by a health certificate and enter at a prescribed port. In the case of some plants (e.g. potatoes, rubber, various species of citrus), however, the rules made under the Act require that the consignment should be accompanied by certificate of health and freedom from scheduled pests and diseases (for certain plants a certificate to the effect that they have originated from estates free from specified pests

* Weiss: 'The criminal prosecution of insects', *Journal of the New York Entomological Society*, XLV, 1937, p. 251.

is also required), while seeds of flax and berseem can be imported by sea only under a certificate from an Agricultural Department in India. Plants infested with living insects and plants carrying living parasitized insects can be imported in a prescribed manner for scientific purposes by the scheduled officers, while living insects and their eggs can be imported according to the rules with special permission from a competent authority and with a certificate of health and freedom from diseases. The Act and the rules made under it would at first sight appear to be complete, self-sufficient and rigid, but on a little closer study they would be found to be wholly inadequate for keeping out injurious insects and fungi from India.

Legislative protection

The most suitable system of legislative protection against insect pests and fungoid diseases should provide for (1) consignments being accompanied by a health certificate, (2) fumigation of the consignments in the country of origin, (3) examination, and (4) fumigation of the consignments at the port of entry.

Even this system is not what one may call an ideal system of legislative protection. It was tried in America and its ineffectiveness has been responsible for the adoption of plant quarantine No. 37 which prohibits the entry of most foreign nursery stock into the U. S. A. Entomologically, the main drawbacks in the system are that the eggs of insects in general and, in particular, of such small insects as scale insects, young ones of white flies and jumping plant lice, borers, and fruit-flies escape detection, while certain scale insects (e.g. *Chrysomphalus aurantii* Mask., *Saissetia oleae* Bern.) are said to resist fumigation. Mycologically, this system is useless: pathogenic organisms may be present and the infection well under way, but it may give no external evidence of its presence; further, fungi and bacteria are generally not killed and disinfected by fumigation with hydrocyanic acid gas. To me the ideal system would appear to be to obtain plants through a well-organized plant import department in small lots from abroad from nurseries and places definitely known to be free from specific pests and to plant these out in an isolated place, under the supervision of a staff trained in the sciences of entomology and mycology. If found healthy, these plants can be propagated and distributed as extensively as desired. This system is liable to interfere with agricultural development: it will be slow and will naturally delay the introduction and multiplication of desirable new varieties of plants, but it will prevent the introduction of all kinds of insects and fungi. It is a well-known fact that insects and fungi that are harmless in their native countries become destructive in their new homes. San José scale is harmless in China although our experience with it is little short of calamitous economically and agriculturally. Therefore it follows that by restricting the introduction of plants into India we shall be doing more good than harm to our agriculture. Thus it seems to me to be highly expedient to review, without delay, our Destructive Insects and Pests Act No. II of 1914 and the rules made thereunder in order to extend their scope so as to make them more effective.

Compulsory eradication

The second line of defence consists in taking measures against the local and exotic pests with a view to eradicating them. To do this the provinces have to obtain sanction of the Governor-General in accordance with sub-section (3) of section 80-A* and of the Governor in accordance with section 80-C, of the Government of India Act of 1919. According to these regulations (1) an organism is declared to be injurious, (2) the infested area is placed under quarantine, and (3) preventive and remedial measures against the injurious organism are prescribed and enforced. In connection with legislation which ensures coordinated effort of affected interests over the entire area of infestation, it should be borne in mind that educative propaganda among the people, directed towards changing their mental attitude and winning over their leaders, is of great value in ensuring its smooth and proper working. In many countries compulsory

* Section 80-A reads as follows: 'The local legislature of any province has power, subject to the provisions of this Act, to make laws for peace and good government of the territories for the time being constituting that province.'

control of the important pests and diseases is a common and regular feature of their war against them, but in India only one out of eleven provinces and four out of seven hundred states have so far followed this system of compulsory control against pests :

Mysore : Coffee stem-borer (*Xylotrechus quadripes*).

Travancore : Black-headed caterpillar of coconut (*Nephantis serinopa*), water hyacinth.

Kashmir : San José scale (*Aspidiotus perniciosus* Comst.).

Baroda : (*Cuscuta*), in the present year it will be enforced in the Baroda district to control the spotted bollworm.

Madras : Cotton bollworm, Cotton stem-weevil, hairy caterpillar (*Amsacta albistriga*), *Nephantis serinopa*, bud-rot of palmyra, spike disease of sandal, water hyacinth. And the results achieved by them have been noteworthy. For example, in Madras people are so convinced of the utility of legal control of pests and diseases that they have petitioned for legislation to control broom-rape of tobacco and mosaic diseases of cardamom. Pests and diseases do not allow cultivators to reap the full benefit from their crops which they nourish and bring to fruition with their sweat and toil. The experience of the Punjab is illuminating in this respect : A clean-up campaign was carried out against the spotted bollworm of cotton over an area of 500 square miles in the districts of Lyallpur and Jhang during 1938—40. As compared with the untreated area the treated area yielded, on an average, 1·6 md. more per acre in the case of *desi* cotton and 1·9 md. more per acre in that of American cotton. Thus by combating the pest cultivators in the 183 villages in the cleaned area of 58,000 acres under cotton actually got 106,000 md. more of cotton than the cultivators in the untreated area. This experience of the Punjab shows clearly that eradication and control of insects ensure more abundant and better production of crops at lower cost. And yet legislation to ensure eradication or control of insect pests and fungoid diseases is very sparingly enacted in our country. But in view of what has been said above, I should like to draw the attention of the provincial and state Governments to the necessity for making greater use of their power to enact laws for the compulsory control of their injurious pests and diseases and the advisability of organizing their plant protection service on a permanent basis because the law, unless enforced through adequate machinery, does not function properly.

Legislative control

The Destructive Insects and Pests Act No. 11 of 1914 permits of inter-provincial legislation to prevent the spread of insect pests and fungoid diseases from infected provinces to other parts of India. So far full advantage has not been taken of this power because, so far as I am aware, no regular survey of the insects and fungi of India has yet been carried out and this survey is an essential pre-requisite for such legislation. Only 50 per cent of the provinces and less than 1 per cent of the states have organized their entomological and mycological services. Moreover, many Indian states are so small that they will never be able to afford regular entomological and mycological services. I therefore consider that a general survey of Indian insect pests and fungoid diseases is a fit subject for the Imperial Council of Agricultural Research to take up. This survey will bring to light our regional destructive pests and diseases and will enable us to enact quarantine legislation so as to keep these dangerous foes confined to their present habitats in which they can be dealt with effectively.

Insecticide and fungicide legislation

To be effective insecticides must contain in a proper chemical combination a definite quantity of the toxic ingredients. The demand for insecticides and fungicides is on the increase in India, but unfortunately the evil practice of adulterating and mislabelling them appears to be becoming common. Indian literature on this point is entirely silent, but the following cases have come to my notice :

1. Lead arsenate samples usually contain 30·6 to 32·9 per cent arsenic pentaoxide.

2. Purity of potassium cyanide usually varies from 31 to 98 per cent.

3. Diesel oil may be adulterated to the extent of 90 per cent.

4. Washing soda, which is an important ingredient of the commonly used rosin compound, may contain 68 per cent of chalk.

It is in the interest of the successful control of pests and diseases of crops that the poison should be of standard purity, because nothing can be more disheartening or disgusting than when the prescribed 'medicine' does not give the results which are claimed for it.

In the Insecticidal Purity Act passed by the United States of America in April 1910 and enforced in January 1911, definite standards for lead arsenate and Paris green are given, and the chemical analysis of other insecticides and fungicides is required to be given on the face of the main label. In my considered opinion similar measures may, with decided advantage, be adopted in India.

CLIMATIC FACTORS IN AGRICULTURE

By L. A. Ramdas

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A COMPREHENSIVE note on the effect of climatic factors on plant growth, crop yield and the incidence of pests and diseases was presented before the fourth meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry held at New Delhi on 20 February 1942. The note in full and a detailed report of the interesting discussion which took place will appear in the proceedings of the Board. The present summary, intended for the lay reader, deals mainly with the planning of future work on crop and weather observations to be recorded at selected experimental farms in India according to a coordinated plan. The Board passed a resolution emphasizing (*a*) the urgency of such work and (*b*) the need for an annual examination of the data so collected and for the regular publication of results for the benefit of the interested public.

Before describing the scheme of crop and weather observations to be adopted in future years it may be recalled that the investigations of crop-weather relationships with the help of available past crop and weather data do show that, in spite of the defects in these data, some general conclusions may be drawn. As an interesting example, high temperatures before sowing time caused an increase in the yield of cotton in the districts of the Bombay-Deccan. The data recorded at individual experimental farms like Akola and Jalgaon led to similar conclusions. Thus the crop and weather data recorded in future years under expert supervision at a Government experimental farm is likely to be of wider application to the tract of country which it represents.

A crop-weather scheme

The times of planting and harvesting a crop will vary with locality. We may consider first of all the time intervals into which the year or season should be divided. It has long been realized that the month is *too large* and the day *too small* a period to serve as a time unit in studies on the development of crops in relation to the intensity and distribution in time of relevant weather factors. To ensure the adoption by different workers of a common plan in this matter it is advisable to divide the calendar year into 'standard weeks' and group these into 'standard periods'. The proposed scheme which is adapted from Sir Napier Shaw's scheme is given below:

Standard weeks of the calendar year

Period No.	Week No.		Dates
I	1	January	1—7
	2	,,	8—14
	3	,,	15—21
	4	,,	22—28
	5	,,	29—4 February
II	6	February	5—11
	7	,,	12—18
	8	,,	19—25
	9	,,	26—4 March*
III	10	March	5—11
	11	,,	12—18
	12	,,	19—25
	13	,,	26—1 April
IV	14	April	2—8
	15	,,	9—15
	16	,,	16—22
	17	,,	23—29
	18	,,	30—6 May
V	19	May	7—13
	20	,,	14—20
	21	,,	21—27
	22	,,	28—3 June
VI	23	June	4—10
	24	,,	11—17
	25	,,	18—24
	26	,,	25—1 July
VII	27	July	2—8
	28	,,	9—15
	29	,,	16—22
	30	,,	23—29
	31	,,	30—5 August
VIII	32	August	6—12
	33	,,	13—19
	34	,,	20—26
	35	,,	27—2 September
IX	36	September	3—9
	37	,,	10—16
	38	,,	17—23
	39	,,	24—30
	40	October	1—7

* In leap years the last week of period II will be 26 February to 4 March, i.e. 8 days instead of 7.

Period No.	Week No.	Dates	
X	41	October	8—14
	42	,,	15—21
	43	,,	22—28
	44	,,	29—4 November
XI	45	November	5—11
	46	,,	12—18
	47	,,	19—25
	48	,,	26—2 December
XII	49	December	3—9
	50	,,	10—16
	51	,,	17—23
	52	,,	24—31†

† Last week of period XII will have 8 days, 24 to 31 December.

The grower's year will vary from crop to crop and also with locality. Whatever be the actual dates of sowing and harvesting of any crop, these dates may be assigned to standard periods and week numbers of the calendar year. Our aim is to record as precisely as possible how the climatic factors of each of the weeks of the grower's year affect the growth and yield of the crop under observation.

Crop observation

The observations should be taken on fields situated close to the meteorological station at the farm. It is desirable that there should be two varieties of crop under observation with five replications. The common or local method of cultivation and rotation should be followed on these plots, there being a separate major plot for each of the crops in rotation. The observations desired in the case of crops like wheat, rice, *jowar* and *bajra* are date of sowing, date of appearance above ground, date of flowering, date of ear emergence, date of harvest, height of crop from time to time and yield per acre of grain and straw. In the case of crops which tiller, the date of commencement of tillering and attainment of maximum tillering should also be noted. Observations on cotton will include date of commencement of flowering buds, date of maximum flowering, date of first picking, number and dates of later pickings, height of crop from time to time and yield of cotton per acre. Soil characteristics, previous cropping, manuring, cultural operations including irrigation with date and quantity and name of variety of crop should be noted together with information regarding incidence and intensity of pests, diseases, etc. It will also be necessary to maintain a crop-weather diary in which brief notes on the weather and the impressions of the observer regarding the effect of weather on crops in general are noted from time to time.

The precision records are simply quantitative observations such as plant, shoot and ear number per unit length, height of shoot, etc. taken according to the specified sampling technique to avoid selective bias. These observations should be made at short intervals of time, usually once a week during the grand period of growth and once a fortnight later on. *Such quantitative measurements of plant growth enable us to determine the principal events which mark the progress of the crop from germination to maturity.* Besides being useful (and necessary) for studying the effect of meteorological factors on growth and yield of the crop the data will also be useful for investigating the relation, if any, between the growth history of the crop up to a given date and the final yield.

It may be pointed out that if the precision records are maintained at say 20 selected centres in different parts of India on the same variety of crops for a period of five years in the first instance the 20×5 or 100 sets of data may be considered as 100 replications for the purpose of preliminary analysis. Provisional conclusions may be drawn long before 25 or 30 years' data are accumulated at each centre. Such periodical examinations will be also of great value in introducing improvements in the observational scheme. At the end of 25 or 30 years it would, of course, be possible to treat the data of each station independently of the others.

The details of the scheme for precision observations are given below. The size of the plot may be $\frac{1}{40}$ acre, except in the case of sugarcane where it will be $\frac{1}{20}$ acre, and the replications five in number. The size and structure of the 'sampling unit' for measurement along rows chosen at random for the different crops are given below:

Wheat. The sampling unit is a metre-length made up of four parallel quarter metre-lengths on adjacent rows. Three such samples may be taken from each half of the plot, giving 30 such samples for the five replications of each variety.

Rice. For *regular* sowing, eight bunches at each random location may be taken, two adjacent bunches being observed after every three bunches omitted, while, in the case of *irregular* sowing, a sampling unit will be a square frame ½ metre by ½ metre, all the bunches in it being observed. Three such sampling units may be taken from each half of the plot giving 30 samples for the five replications of each variety.

Cotton. The structure of the sampling unit may be a two-metre rod, the two plants nearest to the ends of the rod being under observation. Three such sampling units giving six plants may be observed from each half of the plot, the total number of plants for the five replications of each variety being 60.

Jowar and bajra. The sampling unit is a two-metre length made up of two parallel metre-lengths in adjacent rows. Three such samples may be taken from each half of the plot giving 30 samples for the five replications of each variety.

Sugarcane. The sampling unit will be a two-metre rod and for developmental studies the two clumps nearest to the ends of the rod would be under observation. Three such sampling units will be taken from each half of the main plot divided at right angles to the rows. Thus the total number of clumps under observation from each variety will be $(2\times3\times2\times5)=60$.

Growth observations

Periodical growth observations are to be taken by the sampling process suggested above at intervals of a week during the period of rapid growth and a fortnight later on.

In the case of cereals like wheat, *jowar*, *bajra* and rice, germination counts, number of plants and shoots, height of shoots and number of leaves only of plants at the ends of each dissected portion, number of ears, etc. yield as determined by sampling, total yield of plot to compare with the yield as estimated by sampling, number of grains per gramme or five grammes, and moisture percentage in grain for each half of the plot should be recorded.

On cotton the observations to be taken will be height of main stems, number of nodes and their height in centimetres, number of leaves, vegetative buds, open flowers, bolls and yields as determined by sampling method, ginning percentage and staple length.

The following developmental observations of sugarcane should be recorded on the clumps selected:

Number of mother-canes in the clump. (*N. B.* As the mother-canes may not be distinguishable from the tillers in later stages of growth, a string should be tied loosely on each mother-cane at the earliest opportunity.)

Total number of canes in the clump (i.e. the mother-canes plus the tillers).

Number of green leaves in the first mother-cane in each clump; length and breadth of the fully exposed topmost leaf (length from the throat mark or collar to the tip of the leaf blade and breadth at the centre).

Height of first mother-cane in each clump, from the surface of the ground to the highest visible transverse leaf mark. At the time of harvest, the height of the millable mother-canes will be the height up to the transverse mark of the topmost leaf sheath which can easily be separated from the cane by gently pulling the leaf blade.

The circumference will be measured by a cloth tape at the centre of the middle internode of the millable mother-canes.

The number of canes actually included in the sampling unit, i.e. two-metre length of the row (excluding any canes of the clump falling outside the sampling rod) and the weight of the canes in lb. will be recorded. The actual weighing should be correct to one quarter of an ounce.

Brix readings may be taken, where possible, with the help of the hand refractometer once every fortnight when the canes start ripening (about 2½ to 3 months before harvest), the juice being taken from the middle internode of one of the mother-canes from each clump under observation.

At the time of harvest the total weight of canes obtained from each plot should also be recorded separately. It would be advantageous to record the outturn of *gur* obtained from plots in which precision observations were taken to study the variation, if any, of the *gur* to cane ratio.

General observations on the occurrence and intensity of attack of pests like borers and pyrilla and diseases such as smut, red-rot, mosaic, as well as their effects on the growth and yield of the crop should also be recorded. This part of the work will require the cooperation of the local entomological and mycological staff.

The precision observations should be recorded in standard forms which will be provided.

Meteorological observations

The meteorological factors to be observed are rainfall, air temperature and humidity, soil temperature and moisture, wind velocity and direction, evaporation, cloudiness and the incidence of special weather phenomena like thunderstorms, hailstorms, frost, high winds, floods, etc. For this purpose suitably equipped meteorological stations are necessary at experimental farms. The records of the meteorological observations at experimental farms should include both daily observations at specified hours and also notes on abnormal or destructive phenomena. A scheme for regular observations is given below.

At experimental farms engaged in crop research, it is advisable to start with a minimum of meteorological equipment and observations, additions and alterations in these being made in the light of actual experience later on.

The site of the observatory should be a bare plot 60 yards by 40 yards with its longer side running north to south, at the centre of the farm and surrounded by the experimental plots in which the crops are under investigation. The site should be enclosed with barbed wire fencing and should easily be accessible during rains : waterlogging should be avoided. The above size of the observatory site provides for expansion in the meteorological work later on. *The site should be chosen once for all.*

A set of dry bulb, wet bulb, maximum and minimum thermometers and a Piche evaporimeter should be installed inside a Stevenson screen facing north and with its base 4 ft. above the ground. A Robinson cup anemometer and a wind vane should be installed on pillars with the anemometer cups and vane at the average heights of the crops, say 10 ft. above ground. Other instruments required are an ordinary raingauge, a grass minimum thermometer, a sunshine recorder and an Assmann psychrometer.

As experimental farms are concerned with the study of the extreme and mean values of air temperature, humidity, etc. 7 a.m. and 2 p.m. local time are the most suitable hours of observations as they represent approximately the epochs of minimum and maximum temperatures respectively.

At 7 a.m. dry bulb, wet bulb and maximum* and grass minimum† temperatures, wind direction and anemometer readings at 7 a.m., rainfall and evaporation during the past 24 hours, and weather remarks. 'Micro-climatic' observations in the 'open' and in the crop should be recorded with the Assmann psychrometer at three standard levels. These levels would vary with the crop, e.g. in sugarcane the levels will be 1, 4 and 8 ft.

At 2 p.m. dry bulb, wet bulb and minimum§ temperatures and 'micro-climatic' observations in the 'open' and in the crop.

Estimations of soil moisture and apparent density of soil should be made at weekly or fortnightly intervals at depths of 3, 6, 12, 18 and 24 in.

The dates and estimated intensity of irrigation in acre inches should be recorded.

The tabulation of data should be maintained in the standard forms.

It may be hoped that the scheme outlined above will come into operation at a network of experimental farms in India at an early date. Then we should lay the foundation for work on sound lines in future years.

* The maximum thermometer should be set after reading and the test readings of this instrument and of the dry bulb thermometer recorded.

† The grass minimum thermometer should be read *after all the other observations have been recorded.* After reading the instrument it should be kept indoors and exposed again, after setting, only at about 4 or 5 p.m. This precaution is very essential to prevent the spirit column from breaking.

§ The minimum thermometer should be set after reading and the test readings of this instrument and of the dry bulb thermometer recorded.

NEW ECONOMIC CROPS

NEW economic crops are required for India, because the areas under certain crops such as short-staple cotton have to be reduced as the result of the loss of foreign markets, and also because certain products previously imported are no longer obtainable and it is necessary to make arrangements for their production in this country*. By new crops one does not necessarily mean those which have not been introduced into India before and we may consider also those crops which have already been tried on a small scale or have established themselves only on very limited areas and which may be worthy of further exploitation. India, with a variety of climatic and soil conditions, offers great chances for the successful cultivation of exotic plants in different parts of the country.

Need for information

There is a great deal of information regarding trials with such crops carried out in India, which has not been published but which is available with the persons who actually carried out the trials. As a preliminary, therefore, it is desirable that before a list of suitable new crops is actually drawn up arrangements should be made to collect available information from those who have personal experience of these less well-known crops. This information when collected will form a basis for future planning and will be a useful supplement to Sir George Watt's well-known and exceedingly useful *Dictionary of the Economic Products of India*. Due attention would have to be paid to the trade demand and the markets for the raw as well as finished products. Only such crops should be recommended to the grower as are likely to find a ready market.

The figures relating to the economics of production and marketing as given in various reports in the past have become, in most cases, out of date as a result of the conditions brought about by the war. While considering the economics of such crops, these figures, therefore should not be very strictly adhered to.

There is a large number of plants which appear to have distinct commercial possibilities, but the present article is restricted to only a few selected ones.

*At the present juncture the pressing need is for greater food production and in immediate agricultural programmes emphasis should be laid on food crops. The present article is, however, written mainly from a long-range viewpoint.

Papaya as source of papain

Papaya (*Carica papaya*) is a native of Central America and the West Indies. Commercially it is important as a source of papain, a digestive enzyme resembling animal pepsin, and used as a remedy for dyspepsia. Papain is obtained from the juice of the fruits. At the present time the only country producing papain on a commercial scale is Ceylon, which in 1932 exported 45,575 lb. of papain to the United States of America, 16,022 lb. to the United Kingdom and 1,555 lb. to France. In Ceylon 100 to 175 lb. of dried material per acre is the average yield.

In India papaya cultivation has been successful in Madras, Bihar, Bengal, Bombay and the United Provinces, but no large-scale plantations have been tried for the manufacture of papain. A number of high-yielding varieties have been selected for India; of these special mention may be made of Washington, Giant, Hawaii, Ceylon Long, Ranchi Mammoth and Calcutta.

Olive

The olive (*Olea europea*) is a native of western Asia. *O. cuspidata* is the wild olive of Sind, North-Western Himalayas and Kashmir. The ripe fruit properly salted is one of the most sustaining foods known in Europe, where it takes the place of opium, but is without the evils of the drug. Olive oil is one of the finest known in commerce as a food and as a lubricant in wool spinning. The true olive is a very hardy tree, is drought-resistant and thrives well in dry climates with mild winters. Loamy soils are most suitable for its cultivation.

The British Empire produces only negligible quantities of olive oil. Greece with 18·6 per cent of its agricultural income derived from olive is one of the major olive oil producing countries. In India the olive has become established in parts of northern India and bears fruit abundantly, but the fruits sometimes do not mature well and drop down in later stages. Experimental work in connection with olives in northern India indicates that olive cultivation can be made popular at a comparatively low cost. That the climate and soil along the foothills of the northern Punjab and the North-West Frontier Province is suitable for the growth of the olive is evident from the abundant growth of the wild olive. Grafting and budding scions of the best European olive on the wild stock should yield fair crops and it is possible that by suitable hybridization a good-sized fruit may be produced having the natural sweetness of the wild olive.

The plant comes in bearing after five or six years and yields 1½ cwt. of oil olives and 30 to 40 gallons of oil per ton. Some of the best Australian varieties such as Sevillano Macrocarpa, Verdale and Hardy's Mammoth may be tried.

As a part of rural uplift work in the United Provinces olive trees have been planted.

Tung oil

The tung oil tree (*Aleurites Fordii*) is a native of China. The kernels yield a valuable drying oil used in paints, varnishes, etc. Between 1926 and 1928 China exported 54,440 tons of tung oil valued at £29,43,285 annually on the average. This indicates the magnitude of its economic importance in the commercial world.

In India *Aleurites Fordii* and *A. montana* were introduced about 30 years ago and the latter is doing better. *A. moraccana* is also suitable and gives satisfactory yields. The plant comes in full bearing in the tenth year. Fifty to sixty pounds of dry fruits per acre is the expected yield, the oil percentage being about 40.

In view of the growing commercial importance of these trees and of the possibilities of countries like India and Burma possessing soil and climatic conditions suited to their growth, the crop is considered worth raising in many of the warm temperate and subtropical parts.

Hops

The importance of hops lies in the flowers which are used in breweries. According to American experience long and severe winters kill many plants and continued damp or foggy weather is usually followed by severe attacks of lice or mold. Rich alluvial lands or deep sandy or gravelly loams are preferred.

In India, Chamba and Kashmir states show promise of attaining success with hops. In the Himalayan tracts which escape the violence of the summer monsoons, there appears to be a good chance of hop cultivation. The demand for hops for brewing purposes should induce further efforts on the part of the planters. At present large supplies of hops are imported from outside.

Sisal

Sisal (*Agave americana* and *A. sisalana*) is a valuable fibre plant. On account of the ease with which the fibre takes the colour, and its power to bear changes of humidity, sisal-hemp has become important for the textile industry. The plant is also a source of paper material and alcohol is manufactured from its leaves. It flourishes under the most diverse circumstances and dry areas are specially suited to it. After the land has been once planted, very little expenditure is incurred.

Sisal plantations have not on the whole been very successful in India. Sometimes this has been due to the wrong localities being chosen for the different varieties. For example, Java sisal which requires high rainfall has been introduced to dry tracts. Again, African sisal which grows well under 40 to 60 in. rainfall has been introduced to very wet tracts. Sisal cultivation in India could be tried in combination with tea and coffee plantations.

Unfortunately, in recent years the prices of the fibre have been greatly reduced. Nevertheless, there is still a good margin of profit left.

Ramie

Ramie (*Boehmeria nivea*) is another fibre-yielding plant worthy of trial in India. The fibre being the finest and the strongest, is put to several uses, viz. in the making of fishing nets, as fabric for wings of aeroplanes and for the manufacture of parachutes. China used to grow ramie on a commercial scale and export it to Japan. In India it is grown to a small extent in Bengal and Assam. Efforts to raise ramie as a field crop have not been successful in India. It grows best in a warm temperate climate where the winters are cool. Very fertile sandy loam alluvial soil having good drainage is the type of soil required for its successful cultivation.

Cassava

Cassava (*Manihot utilissima*) is a native of tropical America. From the sliced roots manioc or cassava meal is prepared. The starch is used under the name of Brazilian arrowroot, and this when made into pellets on hot plates forms the tapioca of commerce. Cassarup, a powerful antiseptic, is a by-product.

The plant is one of the most productive in the world and it has been claimed that an acre of cassava will yield more nutritive matter than six times the same area under wheat. It was introduced in Travancore about 60 years ago and in the state is next in importance to paddy. Cochin and Malabar also grow it. It will grow in almost any soil and needs very little care. It stands drought well but not frost. The green tops are excellent food for cattle.

Cassava from Java was introduced and multiplied in Mysore some years ago. It has been introduced to Orissa also.

Sago

Sago palm (*Meteroxylon Sagus*) is a native of Malaya. Sago has the characters of starch, is nutritive, easily digestible and hence given during convalescence in acute diseases. The tree flourishes in low, marshy places.

England imports 4,000 tons of sago annually, chiefly from Singapore and Sumatra.

Pistachio

Pistachio (*Pistacia vera*) or *Pista* has its original home in Asia Minor. It is a small tree forming forests, usually on sandstone formations, in Syria, Mesopotamia and Khorasan. The fruit yields resin and oil, and is also used in confectionery. Most of the supplies of pistachio nuts are received in India from Persia, Palestine and other neighbouring countries.

From the recorded evidence of the existence of this tree in Rawalpindi, Srinagar and Kashmir, there appears to be no reason why with a little trouble, the cultivation of this valuable tree should not be carried on with success, at least along the whole of the north-western frontier.

It has been observed that the seedling plants do not usually fruit. In this direction budding and grafting may help in overcoming this difficulty.

Stramonium

The drug stramonium is obtained from *Datura stramonium*. India is the only country where both *D. stramonium* and *D. fastuosa* grow plentifully. In spite of all this, most of the stramonium preparations in the market are imported from outside.

Considering the importance of the drug and the ease with which the Datura plants could be grown it would be worth while having regular plantations in places which are otherwise not suitable for general cultivation.

Liquorice

This drug is the dried root of a leguminous plant, *Glycyrrhiza glabra*, found in the sub-Himalayan tract in the Punjab. The commercial supplies, however, come from Asia Minor, Turkestan and the areas surrounding the Persian Gulf. It is also cultivated in China, France, Italy and Germany. The preparations of liquorice are very popular both in the western and Indian systems of medicine. It is used in the preparation of various cough lozenges and also for sweetening medicines. There is a great demand for this drug and its cultivation can be safely recommended.

Derris

The roots of *Derris elliptica and D. malaccensis* contain rotenone, used in large quantities in the manufacture of insecticides. The world's supplies come from Malaya and

neighbouring islands. In the first instance it is not possible to obtain supplies from these localities at present. Even if it were available the foreign product is so costly that its purchase is simply prohibitive. We want cheaper supplies for India. The indigenous species of Derris are very low in rotenone content, hence attempts should be made to acclimatize some of the exotic species. There is good scope for their cultivation in India.

Besides such crops as cinchona and pyrethrum—the large-scale cultivation of which has already been advocated in the past—there is a long list of plants including digitalis, peppermint, belladona, ergot, calophyllum, chenopodium, vanilla, camphor, cascara, rozelle, celery, etc. which merit attention. The soybean has not been mentioned because there appears to be, at any rate at present, no market for it in India, and further the nutrition experts do not consider that as a pulse food it is superior to the pulses indigenous to the country. There is also a need for the trial of new fodder plants such as the Giant Star Grass from East Africa. Some of the new varieties produced by crossing sugarcane and sorghum have possibilities as drought-resistant fodder plants.

Bureau for new crops

It should be made clear that plants about which notes have been given above are by no means recommended to the public for immediate cultivation. As has already been stated earlier, it is desirable that we should first collect and collate the available information on the less well-known economic plants in India. The data so obtained would then have to be considered by a planning committee on which Directors of Agriculture, Economic Botanists, and the trade and the marketing organizations would be represented. Such a committee would then be in a position to offer authoritative recommendations as to what new economic crops should be grown and where. When the subject of new economic crops was recently discussed at the meeting of the Crops and Soils Wing of the Board of Agriculture in India it was suggested that the state should give a guarantee against loss to growers who are prepared to undertake trials with new plants.

It was also suggested that besides the action to be taken immediately it was desirable, as a matter of long-range policy, to establish a Bureau for the introduction and testing of varieties of plants, similar to the organizations existing in the United States of America and several other agriculturally advanced countries. The function of the Bureau would be to collect material from all parts of India and from abroad for preliminary testing and despatch of such material as merited further test to such regions of the country as appeared to be suitable for it. It would keep in touch with the industry and trade so that the commercial possibilities would be tested as early as possible. Arrangements would have to be made for suitable quarantine arrangements to see that no new pests or diseases are introduced into this country along with imported material.

If such a Bureau is set up, we should have the means of exploiting the plant material of the whole world for the varied climates and soils of this sub-continent and we should be in a position to give clear recommendations as to what additional crops could be grown with profit and where.

What the Scientists are doing

VETERINARY RESEARCH

IN the absence of the president-elect, Dr C. G. Pandit, who could not preside over the Medical and Veterinary Research Section of the Indian Science Congress on account of his being called to America in connection with the present war, the sectional committee elected Dr G. D. Bhalerao, D.Sc., Ph.D., to preside over the deliberations of the section and to conduct all the business connected with the office of the President. Mr M. R. Mahajan, M.R.C.V.S., was appointed by the committee to act as recorder.

In their first meeting the sectional committee recommended to the executive committee that Dr F. C. Minett, D.Sc., M.R.C.V.S., be elected President and Dr Panja the recorder of the Section for 1943. The recommendations of the committee were carried out in the executive committee. Dr V. S. Mangalik was appointed local secretary and Mr D. N. Banerjee the sectional correspondent.

Dr V. S. Mangalik read a paper on observations on hæmatological survey of poor-class families in and round Lucknow. As a result of his investigation it was found that the hæmatological values for males was 13·3 gm. per cent and that for females was 10·58 gm. He advanced the theory that in spite of insufficient iron intake, these people showed satisfactory hæmoglobin levels because of the iron they take from iron utensils in which their food is very often cooked. The paper was followed by discussion and queries by Mr Chadda, Mr Mahajan and Dr Bhalerao.

Dr Chatroja read a paper on urea contents of the blood in cases of enlarged prostate. It was followed by a discussion and suggestions by Dr Mangalik, Dr Mundhe, and Mr Gopalkrishnan.

Mr V. R. Gopalkrishnan read a paper on paratyphoid in pigeons in Assam. It was followed by numerous queries which were satisfactorily answered. He stated that salmonella infection of birds is of public health importance as there is a possibility of food poisoning in human beings with *S. typhimurium*.

Dr Mangalik then read a joint paper on gastric acidity in Indians with alcohol test meal. It was stated that alcohol test meal had replaced the old gruel meal in most of the bigger hospitals. Acid response was studied according to community, sex, influence of diet and age. Some cases of achlorhydria were also studied. Data were collected on gastric response in various types of anæmia.

Dr S. N. Ray in his paper maintained that osteomalacia-like symptoms in cattle are due to fluorine intoxication. He referred to the micromethod which was specially devised to estimate very low concentrations of fluorine. Mr Mahajan, Mr Chadda and Dr Mundhe related their experience regarding the condition.

Swami Pranavananda of Kailas and Manassarovar then read a very interesting paper on musk and musk-deer. His observations revealed that the common belief that the musk is contained in the navicle or the testicles of the musk-deer is entirely erroneous. His careful dissections led to the conclusion that musk is a secretion of the prostate gland. Several uses and properties of musk were related. Various sample of musk and musk pouches, counterfeit and real, were exhibited.

Mr Inamdar read the paper of Prof. Gideon on the biological control of guinea-worm. The author advocated the use of cyclops-eating fish and chlorogen in the control of the disease. Dr Bhalerao remarked that biological control was the best method of controlling diseases. He quoted his experience in the control of some helminths and malaria.

Mr V. R. Rajagopalan's paper on pseudo-tuberculosis in goats was read by Mr Gopalkrishnan. Mr Mahajan read a paper on tuberculosis in an elephant. He stated that the strain of tubercle bacilli was of bovine type.

The presidential address of Dr Pandit on 'Immunity in Virus Diseases' was read by Dr Bhalerao on 5 January, with the General President, Mr Wadia, in the Chair.

Rai Bahadur K. N. Bagchi read a joint paper on the arsenic content of common food-stuffs in India. About 100 different articles of food were stated to be analyzed. The joint authors observed that marine fishes contained more arsenic because sea water was richer in arsenic than fresh water. They emphasized that the investigation was important from the point of view of the forensic toxicologists who are required to express opinion as to the amount of extraneous arsenic in the stomach contents of suspected cases of arsenic poisoning. Several other important papers were taken as read in the absence of the authors.—(G. D. BHALERAO).

FOR I. C. S. PROBATIONERS

FOLLOWING the practice started last year, Dr W. Burns, D.Sc., C.I.E., Agricultural Commissioner with the Government of India, delivered two lectures on agriculture to the I.C.S. probationers under training at Dehra Dun. These lectures were delivered on 6 and 7 March. The first lecture dealt with the conditions of crop production in India, i.e. the soil, the seed and the system of cultivation ; and the second dealt with certain crops, particularly rice, cotton and sugarcane, also with the organization of the provincial Departments of Agriculture and with the part which I.C.S. officers could play in agricultural development. After each lecture, questions were asked and a discussion took place for about a quarter of an hour.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. We hear of animals being made insusceptible to various infectious diseases. I should like to know how this protection can be brought about.

A. The protection given to animals against the more deadly infectious diseases is brought about by injecting into their bodies the microbes causing those diseases or the poisons which these microbes produce but killed or weakened by various methods in such a way that they are no longer capable of setting up the actual diseases. Although this is so, these altered microbes or poisons stimulate the formation in the body of protective substances commonly known as 'anti-bodies'. These substances are found not only in the solid tissues of the body but also in the blood and in the serum of the blood—after it has clotted—of the animal and enable the body to resist the invading microbes either by destroying them, or by rendering their poisons inert. Protection or immunity produced in this way is known as artificial immunity, in contradistinction to that which is naturally acquired by recovery from an actual attack of the disease.

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Q. From what source and in what manner are the following immunizing substances obtained: (a) sera, (b) vaccines?

A. Immune sera in large amounts are obtained from buffaloes, horses and cattle, which have been injected with repeated doses of live weakened or dead microbes or microbial poisons technically known as toxins. After a suitable delay the animals are bled from the jugular vein and the serum obtained after coagulating of the blood is used.

Vaccines.—The microbes causing the disease are cultivated artificially in the laboratory on certain nutrient materials. The resulting growth or culture is collected and standardized, so that a given number of microbes are contained in so many drops of the fluid, and finally heated at a temperature high enough to kill them without destroying their immunizing and protective power.

Sera and vaccines are of value only against the microbes which have been used for preparing them. Thus rinderpest serum is no use against foot-and-mouth disease or anthrax, while anthrax serum is only of use against anthrax. The question of diagnosis therefore assumes the greatest importance.

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Q: I should be grateful for the following information:

1. Scope for canning of milk in India.

2. Suitable book or books, which deal in detail with the methods of canning milk.

3. Finance required, with a rough sketch of 'capital' and 'revenue' expenses.

4. Availability of requisite machinery, and the address of the supplier.

5. Names of suitable towns in the United Provinces where the industry can be started with profit.

A: (1) Demand for condensed (canned) milk is large in this country, as can be seen from the imports before the present war. The demand must be still greater now for war purposes. Ships, restaurants and troops consume large quantities and for ascertaining the actual demand before launching upon the scheme, necessary inquiries should be made.

(2) *Condensed Milk and Milk Powder* by

Otto F. Hunziker, obtainable from the author, care of La Grange, Illionois, U.S.A., may be consulted (price Rs. 30).

(3) The quantity of milk proposed to be handled, the kinds of condensed milk to be made, purchase price of and the sale rates of condensed milk have to be taken into account in determining capital and revenue expenses.

(4) Milk condensing machinery is not available anywhere in this country. It is also difficult to get it constructed. Import is out of the question because of the present war situation. Enquiries may, however, be made of Messrs Larsen & Toubro, Bombay, or Messrs Graham & Co., Rutland Square, Edinburgh.

(5) It should be possible to obtain cheap milk round about Aligarh or in the Budhan district of the United Provinces.

Regarding successful manufacture of condensed milk from the types of milk now available in the United Provinces, it may be pointed out that there is nothing to guide the manufacture, as no work (experimental or commercial) has been done so far. Buffalo milk, which is very largely available today, may present difficulties. Special tin cans present another problem.

FOOD FOR INDIA'S MILLIONS

By F. M. de Mello, B.A., B.Sc. (Econ.)
Editor, Imperial Council of Agricultural Research

FEW resolutions of the Advisory Board of the Imperial Council of Agricultural Research have evoked more widespread comment and public support than the resolution passed during the February session concerning the importance of initiating a food production drive without delay. The subject was discussed in the Developmental Research Committee, and there was further discussion at the meeting of the full Board which was attended by the Hon'ble Mr N. R. Sarker, Chairman of the Council.

Shortage of rice and wheat

India is considered to be a country of enormous agricultural resources, but even in normal times the internal consumption of food grains is greater than the production. Before the present war India used to import 1½ to 2½ million tons of rice annually from Burma. The average shortages in respect of rice and wheat in the deficit provinces and states are as follows :

	Rice (Tons)	Wheat (Tons)
Madras	778,000	..
Bombay	482,000	236,000
Bengal	64,000	210,000
United Provinces	205,000	..
Bihar	191,000	23,000
Orissa	..	5,000
N.-W. F. P.	6,000	1,000
Delhi	11,000	34,000
Hyderabad	75,000	2,000
Mysore	48,000	12,000
Rajputana	31,000	68,000
Central India	14,000	88,000

These shortages could, however, be made up by imports from other parts of India and also of rice from Burma and wheat from Australia and during the last war were so made up. But owing to the military situation in the Pacific and in Burma, our foreign sources of supply are virtually cut off and the problem before the country is to produce a sufficiency of food for the civilian population and for the support of Indian armies at home and abroad. Though India as a whole may be a deficit country in regard to the production of the main food crops, there are some provinces with surpluses ; but the increasing difficulties of transport by road or by rail owing to petrol rationing and congestion of the railways poses another problem of the interprovincial distribution of food surpluses. The result of these difficulties has been a rise in prices which price control has not been able to check. If in these circumstances there should be a failure of the monsoon over a large area, the consequences could be better imagined than described.

Central policy needed

The Board, therefore, considered the necessity of coordinated planning of crop production so as to eliminate the surpluses of non-food crops such as short staple cotton as well as deficits of food crops such as rice and wheat. Members felt that a central agricultural policy was needed for the guidance of the country. As the present problem was one of scarcity of food, the measures required to induce the farmers to grow more food were discussed in some detail. Mr Roger Thomas of the Sind Land Development Syndicate, Mirpurkhas, who moved the resolution, contemplated crop control, but the principle of compulsion was generally opposed on the ground that it would be impracticable. On the other hand, it was agreed that in order to bring additional food supplies into being, an inducement should be offered in the form of a guaranteed price. Another way of directing energy into food production, it was agreed, would be to charge discriminatory water rates and land assessment.

Undoubtedly propaganda of the right sort is needed to drive home to the cultivator that to grow more food crops is both a national duty and a profitable enterprise. Many suggestions were made in the course of the discussion regarding the ways by which provincial and state Governments could help the farmer to raise more food. The distribution of seeds and manures, the increase of water supplies for irrigation, the improvement of agricultural credit—these were practical measures to help the cultivator. More extensive forms of assistance were the organization of transport from region to region and the provision of storage facilities for surplus grain. The feeling of the Board was that since the *kharif* crops are to be sown by June immediate action was necessary and that a conference of provincial and state Governments should be called by the Government of India without delay.

Resolution passed

The resolution, amended in the light of the discussion, was unanimously passed. It is as follows:

'The Advisory Board strongly affirms the need for the organized planning of crop production in India so designed as to guard, in so far as may be found feasible, against the shortage in production of essential agricultural commodities. It therefore commends to the Government of India the urgent need of so planning agricultural production on a coordinative nation-wide scale, as best to meet the country's wartime needs.

'With this end in view the Board commends to the attention of all provinces and states the desirability of:

(*a*) guaranteeing fair prices for all food grains on a coordinated regional basis;

(*b*) of accepting tenders of food grains at the guaranteed prices;

(*c*) of providing storage for food grains on Government account;

(*d*) of making adequate provision for the supply of seeds of food crops prior to sowing time at concession rates;

(*e*) of financing the construction of wells for irrigation and of embankments in non-irrigated areas;

(*f*) of supplying or arranging for the supply of adequate manures to cultivators;

(*g*) of intensifying propaganda, through the agency of all the concerned departments and institutions, on the desirability of increasing the production of food crops.

'The Board further commends to the Government of India the desirability of:

(*a*) granting priority in facilities of rail, road, and maritime transport for seed, manure, and foodgrains, in the interests of increased production of foodgrains,

(*b*) giving help to the provincial and state authorities, and

(*c*) convening as early as possible, a conference of representatives of provinces and states to consider practical measures for the coordinated planning of crop production in respect of the *kharif* sowings for which provision for seed, manures, etc. has to be made by April.'

The conference of representatives of provinces and states assembled at Delhi on 6 April.

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.)

Associote Professor of Agriculture, Punjab Agricultural College, Lyallpur

SINCE the time it became known that the climatic and other conditions in some parts of the Punjab were congenial for the growth of long-stapled American cottons, the Department of Agriculture has been engaged in introducing such cottons to replace, as far as possible, the indigenous short-stapled varieties which in the early twenties were grown over practically the whole of the province. Efforts of the Depart-

ment in this connection were successful as far back as 1914, when 4F, the first acclimatized variety of American cotton capable of spinning 20-25 counts, was released for cultivation. By virtue of the premium that this cotton commanded, it was well received and the area under it in subsequent years swelled to several lakhs of acres. Up to this day it is still the most extensively cultivated variety of the Punjab-American cottons. However, with India having to compete with other cotton-growing countries, it became imperative that new varieties with longer and finer lint than that of 4F cotton should be bred for introduction in the Punjab. Efforts in this direction have already borne fruit and several very fine cottons are available and are steadily replacing the medium-stapled 4F variety. L. S. S.—a selection from 4F—is, at present, popular in the districts of Lyallpur, Sheikhupura and Sargodha, while 289F/43 and 289F/K25 are the fully established commercial cottons of the south-western tract and the Lower Bari Doab Canal colony.

New commercial cotton

In addition to these types, a new variety which has recently been bred at the cotton sub-station, Multan, and which is likely to become the commercial cotton of the Punjab is 124F. In the extensive field trials carried out with this variety during the past four years with a view to delimiting the areas for which it was suitable, it has given a very good account of itself in all tests carried out in the south-western tract and in the Lower Bari Doab Canal colony, where it has proved to be a better yielder than both 289F/43 and 289F/K25. Its lint length, like that of 289F/43 and 289/K25 approaches 1 in., and in the spinning tests carried out at the Technological Laboratory, Matunga, it spun 43 counts as compared to 40 from other similar types. Another asset of this cotton is its high ginning outturn, viz. 33·3 per cent and in this respect it almost approaches 289F/K25, which is hitherto known to be the best ginner among Punjab-American varieties. Earliness is another characteristic of 124F, which is likely to impart to it the invaluable virtue of drought resistance. It is, however, inferior to 289' F/43 in jassid resistance but is slightly better than 289F/K25. It has chances of succeeding only in those tracts of the Punjab where jassids are not a serious menace to the cotton crop.

Bloodred oranges

No other variety of malta orange has appealed to the public as the Bloodred, for a really red-fleshed fruit easily fetches twice the price ordinarily fetched by other varieties. The popularity of the Bloodred orange can be judged from the large number of indents received by Government nurseries, which easily account for two-thirds to three-fourths of the total indents for all kinds of citrus plants put together. The value of the Bloodred orange lies mainly in the intensity of red colour in the flesh. There is, however, one difficulty which has always baffled fruit-growers in the Punjab. The red colour does not develop invariably in all the fruit on a tree. In order to ascertain the cause, investigations were carried out at the Punjab Agricultural College in 1939-40 and 1940-41, which involved the examination of 2,860 fruits obtained from 30 Bloodred orange trees selected at random from five orchards in the citrus-growing tracts of the Punjab. It was found that the fruit on the north-eastern and the north-western sides developed better colour than that on the south-eastern and the south-western sides of the trees. The fruit on the south-eastern side of the trees developed the least colour. Further, the fruit on the lower half of the trees developed better colour than that on the upper half of the tree. Again, shaded fruit even on the south-eastern and the south-western sides of the trees developed better colour than those exposed to the rays of the sun. Trees protected against the sun on the south-eastern and the south-western sides by any protective hedge preferably of *jantar* (*Sesbania egyptica*) developed better colour in their fruit than those trees which were not similarly protected. It is quite clear that exposure of the fruits to the hot rays of the sun in some mysterious way checks the development of the red colour. Fruit-growers in the plains are therefore advised to plant *jantar* trees on the south-eastern and the south-western sides of their orchards, particularly if they

are growing blood-red malta plants. This protective hedge will provide shade and improve the quality of fruit.

Groundnut in the Punjab

The introduction of groundnut in the Punjab is very recent, and within the past few years its spread in certain districts having a fairly heavy rainfall, humid climate, friable and porous soils has been remarkable. The success of this crop is manifest from the fact that the area under it rose from about 240 acres in 1931 to 37,284 acres during 1940.

Groundnut is at present grown on a fairly extensive scale in parts of the Ludhiana and the Ambala districts where cultivators have found it more remunerative than crops like *jowar*, *moth*, *mung*, etc. previously grown on *barani* (rain-fed) lands. The soil and climatic conditions in some other districts, viz. Rawalpindi, Jullundur, Hoshiarpur and Gurdaspur also appear to be somewhat congenial for raising a successful crop of groundnut there.

As a result of extensive trials extending over five years with a very large number of varieties imported from other provinces of India or abroad, two improved selections, A-2 and B-1 (both spreading) were brought on the approved list of departmental seeds during 1935 and released for distribution. Of these A-2 is more suited to the Rawalpindi district, while B-1 has done well under the conditions prevailing in some parts of the Jullundur division. More recently in 1937-38, a new selection named D-3 has been added to the approved list of the departmental seeds, and has given universally good results in the extensive tests carried out under varying conditions of soil, climate and moisture. This variety has the spreading habit of growth and takes about five months to mature. Its outstanding merits which have enabled it to become popular with the growers and traders are given below:

(1) *High yield.* In the large-scale trials conducted so far D-3 has done best. It gave at Ludhiana in 1940 a maximum yield of 28 md. of pods per acre. Considering the average results obtained during the past three years it has again topped the list with 14 md. as against $12\frac{1}{2}$ md. and $11\frac{3}{4}$ md. of pods per acre obtained from A-2 and B-1 respectively. Under favourable zemindari conditions also, D-3 has done best, giving as high a yield as 25 md. of pods per acre.

(2) *High seed-to-pod ratio.* The pods of D-3 are thin-husked and well filled with seeds. Consequently, it gives a very high percentage of seed-to-pod ratio, viz. 66 per cent against 57 per cent and 62 per cent in the case of A-2 and B-1 respectively.

(3) *High oil content.* As a result of the analytical tests, the seeds of this variety are found to possess the highest percentage of oil among the improved varieties given out so far; the percentage of oil was found to be 48·88, 42·44 and 45·24 in the case of D-3, A-2 and B-1 respectively.

(4) *Hardiness.* Owing to the deep and most extensively developed root system D-3 can withstand drought to a very great extent. It has also been found to possess a fair degree of resistance to root-rot which attacks the crop seriously in some parts.

(5) *Better market value.* The pods of D-3, though comparatively small in size, are fairly uniform and attractive in appearance. Due to this and other valuable merits, the pods of this variety usually fetch a premium of 6 to 8 as. per maund in the market.

SIND

By L. M. Hira
Senior Marketing Officer, Sind

HIS Excellency the Viceroy, accompanied by H. E. the Governor of Sind and personal staff, visited the Willingdon Cattle Farm, Malir, on 9 January and was received by the Hon'ble Rao Sahib Gokaldas, Minister for Agriculture and Rao Bahadur K. I. Thadani, Director of Agriculture, and was introduced to Mr J. H. G. Jerrom, Director, Veterinary

H. E. the Vicer
inspecting t
Willingdon Catt
Farm stock

Agmark stall displaying various graded products. Visited by H. E. the Viceroy on 9 January 1942 at the Willingdon Cattle Farm, Malir, Karachi.

Services, Khan Sahib Ali Mohammed Ulvi, Live-stock Officer, Dr L. M. Hira, Senior Marketing Officer, and Mr Jote. D. Advani, Manager of the Farm.

The cattle exhibited included the champion bull of Sind, Haroon, the champion cow and the champion heifer, which won awards at the last All-India Cattle Show, as also at the recent regional show at Bhavnagar.

H. E. the Viceroy inspected various demonstration stalls that had been set up on the Farm on the occasion including the Agmark stall, which showed various graded products like ghee, eggs and fruits, the dairy stall and the propaganda stall where a film on the boll-worm was shown in an enclosure to those present.

The Viceroy was thereafter taken round the Farm before he departed.

Jacobabad

The annual horse and cattle show at Jacobabad was held from 18 to 24 January. Jacobabad is on the border of the Bhagnari breeding tract and therefore cattle brought to the show are mostly of the Bhagnari breed—one of the best breeds of draught cattle in North Sind. The tract is also well known for its robust, vigorous and virile horses which surpass many other Indian breeds in graceful build, stamina and swiftness.

The Upper Sind Frontier District Local Board which organized this show awarded prizes of the value of about Rs. 2,000.

The best horse in the show was exhibited by Sardar Nazarmohmed Shahani and the best Bhagnari bull by Khan Sahib Suhrab Khan Sarkhi. In class VII (cows in milk), the highest yield of milk obtained was 23 lb.

Besides livestock, there were agricultural, industrial, rural reconstruction and public health exhibits, shown by various Government departments. The Agricultural Department put up a very good show which consisted of improved agricultural implements and machinery, seeds, plants and products of improved strains of various crops.

The Marketing Section took active part by exhibiting and demonstrating various graded products and their grading.

H. E. the Governor of Sind accompanied by Lady Dow visited the show on 21 January and evinced keen interest in all the exhibits.

Rural development

The Rural Reconstruction Department did the following useful work during 1940-41 :

New wells with water troughs for cattle constructed	49
Manure pits maintained . . .	459
Ventilators and windows fitted . .	260
Model villages constructed . .	3
Fruit and shady trees planted . .	4,160

A big pool of stagnant water was filled and levelled on a contributory basis at the cost of Rs. 1,880.

To improve the stock of cattle nine cattle shows were organized and 22 stud bulls at as many rural reconstruction centres were maintained. During the year 765 cows were covered by these stud bulls and 195 bulls were castrated. Seven veterinary chests were also placed in selected areas.

New schools opened

Along with better farming and better business, the desire for education is apparent at all the villages selected for rural reconstruction and the members now appear to be keen on sending their children to school. Sixty-four mixed primary schools with a strength of 3,728 boys and girls and thirteen schools purely for girls with 519 pupils were opened in the selected areas. Two hundred adults attended night classes at various centres.

Apart from 92 one-day demonstrations, six annual rural reconstruction shows lasting two to three days were organized on a grand scale in different centres. All the publicity sections of the various nation-building departments participated in the shows, and lectures and demonstrations on improved methods of cultivation, marketing, cooperation thrift, and cleanliness, and such other topics were given.

In addition to this, interesting films on adult education, model villages, prevention of tuberculosis, the life-history of the house-fly, etc. were shown.

ASSAM

By S. Chakrabarti, B.A. (Hons.)
Assistant, Office of the Director of Agriculture, Assam

A MEETING of the Agricultural Section of the Assam Advisory Board for Development was held at Silchar in January with Dr S. K. Mitra, Director of Agriculture, Assam, in the chair. The following members of the Board attended the meeting: Messrs R. C. Woodford, Deputy Director of Agriculture, Livestock; N. K. Dutt, M.L.A.; B. B. Das, M.L.A.; Md. A. Salam, M.L.A. and Rai Sahib P. N. Chowdhury. Messrs N. K. Das, Senior Marketing Officer and S. Majid, Deputy Director of Agriculture, Surma Valley, also attended the meeting as visitors.

Repairing flood damage

The situation created by the destruction of the main paddy crop of the Surma Valley by flood last year dominated the discussions at the meeting, which adopted three resolutions on the subject recommending early action for making good the shortage in the supply of paddy caused by flood. By one of the resolutions Government was requested to secure further relaxation of the restrictions imposed by the Manipur State on the export of paddy and rice from Manipur, while by another resolution the Board emphasized the necessity for restricting export of rice and paddy from Assam. By a third resolution it requested the Government to make adequate provision for the supply of *amon* (broadcast deep-water winter paddy) and *aus* (summer and autumn paddy) paddy seeds in the Sylhet District, which suffered most from last year's flood.

Members spoke strongly on the subject of providing adequate facilities for training in agriculture and animal husbandry and the Board unanimously adopted a resolution for the establishment of two agricultural schools in Assam—one for the Surma Valley and one for the Assam Valley. The Board also recommended that steps should be taken for organised marketing of paddy.

The major rice pests in Assam are rice swarming caterpillars, rice case worms, rice stem borers, rice bugs, army worm caterpillars, rice hispa and rice hoppers; and the areas mainly affected are the districts of Nowgong, Sibsagar, Lakhimpur, and the Jaintia Parganas of the Sylhet district. In some of the places the incidence of attack sometimes becomes so heavy that control of pests becomes wellnigh impossible. The Department of Agriculture has, however, been able to bring these pests under control in most of the affected areas and this has been possible largely through the cooperation of the clutivators. The Department maintains two Entomological Assistants, one for the Surma Valley and one for the Assam Valley. They carry out surveys of the affected localities, find out means of controlling the pests and then carry out control campaigns with the help of the demonstration staff of the Department and the cultivators. Different methods have been devised for the control of different pests, and of them the destruction of adult insects by means of light traps, removal of affected plants, bagging and destruction of adults by putting them in kerosenized water have been found to be quite effective. When an outbreak is reported, the Entomological Assistant concerned inspects the area and then a campaign for the control of pests is launched according to his advice. The demonstration staff organize control demonstrations with the help of kamdars. Frequent meetings are held and pamphlets distributed, the cultivators are organized and the campaign then starts in earnest. By these control campaigns big cropped areas are being saved from the ravages of insects and, incidentally, the cultivators are learning to depend more and more on their own resources for the betterment of their lot.

Seed farms

To increase stocks of improved seeds, seed farms have recently been established in each of the three agricultural divisions. In the Surma Valley two seed farms have been started—one at Malugram (Cachar district) and one at

Gobindpur (Sylhet district). In the Upper Assam Valley one such farm has been established at Senchoa in the Nowgong district, while three seed farms have been started in the Lower Assam Valley—one each at Ulubari (Kamrup district), Dalgaon (Darrang district) and Dumardoha (Goalpara district). A sum of Rs. 6,000 has been provided in the current year's budget for running these farms, and it is expected that improved seeds will now be produced and issued in bigger quantities and on easier terms. Moreover, it will now be possible to find out strains suited to the soil conditions of the different agricultural tracts.

Fruit preservation

Assam is an important fruit-growing province, growing chiefly oranges and pineapples. It is estimated that there are still several thousand acres of land which could be utilized for the cultivation of these and other fruits. Oranges are grown mainly in the region lying across the southern slopes of the Khasi hills bordering on the district of Sylhet. Large quantities are produced here and exported. Both production and export are expected to increase with the application of the results of the research now being done, with the financial assistance of the Imperial Council of Agricultural Research, at Burnihat. In the south of the Khasi hills pineapples are also produced. In the Surma Valley (which comprises the districts of Sylhet and Cachar) low hillocks are a common sight and these have been put under oranges and pineapples at many places. Sylhet is the most important district in Assam in regard to the production of pineapples. Calcutta gets 90 per cent, if not more, of its supply of pineapples from Assam. In regard to oranges, not only Calcutta but many other markets of Bengal derive large supplies from Assam, the Khasi hills and the Surma Valley districts contributing a large proportion. There is, however, room for the development of this industry in Assam. Under existing conditions, large quantities of oranges and pineapples go to waste for various reasons, a very important one being Assam's dependence on distant external markets. Picking, selection and packing of fruits are done on old-fashioned lines. Transport of oranges in loose condition by country boats over long distances also causes loss. Culls and windfalls in orchards contribute not a little to this waste. The Department of Agriculture is doing everything in its power to improve the agricultural and marketing sides of this industry. There is, however, another effective way of reducing the huge annual loss. Much of the waste that now takes place could be avoided if canning and preservation of fruits could be introudced. For this purpose a five-year scheme of Rs. 31,000 has recently been submitted to the Imperial Council of Agricultural Research. If the scheme is sanctioned by the Imperial Council and the contemplated work can be started, there is no reason why Assam's fruit industry should not register rapid progress.

Sheep-breeding

Sheep-breeding on a very small scale is being conducted at the Upper Shillong Farm, near Shillong, with a few Bikanir and Hissar Dale sheep, which were purchased from the Hissar Cattle Farm in 1933. These sheep have done surprisingly well and the fourth and fifth generations are now being born in Shillong. Encouraged by the success of this trial, the Department has recently submitted a five-year scheme of Rs. 28,500 to the Imperial Council of Agricultural Research for extending this breeding work by taking up investigations on the following lines.

(i) Testing the adaptability of the Hissar Dale breed to the conditions of the hills of East India and comparing live-weights and quantity and quality of wool produced in Shillong with similar records maintained in the Hissar Farm.

(ii) Ascertaining the least amount and best kind of artificial feeding required to keep these sheep in good health and production under Shillong conditions.

(iii) Study of the effect of lambing twice a year on ewes.

(iv) Improvement by selection, in both maintenance of constitution under the new conditions and wool yields.

The Month's Clip

DEFECTS OF NEW ZEALAND WOOLS

THE Wool Research Committee of the New Zealand Council of Scientific and Industrial Research, acting in cooperation with the Wool Industries Research Association, Torridon, Leeds, decided that, in order to ascertain what are the limitations of the wool from some of the leading Romney and Corriedale stud flocks, representative fleeces from these flocks be sent to the Wool Industries Research Association for the purpose of (1) obtaining a trade opinion thereon, (2) a laboratory examination, and (3) a manufacturing test. This was necessary for bringing about improvement in the cross-breds after knowing the limitations of the stud sheep available.

The trade opinion was that, while there may be some fleeces not up to the desired standard, the majority are quite satisfactory to at least certain sections of the manufacturers. This does not mean that the fleeces are ideal and no improvement is possible. What it indicates is that, with some of the better stud flocks to act as a foundation for the beginning, it should be possible, by the employment of better breeding, feeding and management of the cross-bred flocks, to raise the standard of New Zealand wools.

The conclusions arrived at from the results of the laboratory examination of the New Zealand fleeces were that the factor of the shape of cross-section of the fibres probably is more important from the point of view of a good spinning wool than is the evenness of the size of the fibres, and that in all probability there is a relationship between the percentage of sulphur in a wool and the manufacturers' idea of a good or a bad spinning wool. It is also pointed out that apparently there is some correlation between the shape of the wool fibres and the 'handle' of the wool, a wool with a soft handle having fibres more nearly approaching the circular than the fibres of a similar wool, but with a harsher handle. It has been shown that medullated wool fibres are lower in sulphur content than are normal wool fibres. It has also been noted that feeding can affect the percentage of sulphur in the wool, so it may be a combination of a naturally low sulphur in the wool and a limited supply of sulphur in the blood-stream that is a contributing influence in the production of medulla.

It is difficult to assess the economic importance of each defect, since it has to be remembered that the first essential of wool is that it shall act as a protective covering for the sheep and that in the case of the fat lamb other factors such as the demand for early maturity and shape of carcass are of more importance than is the wool produced by the lamb. The following are some of the defects :

Presence of irregular fibres

This probably is the most outstanding defect in New Zealand wools, and the irregularity may take a number of different forms.

(*a*) *Marked variation in size of fibres accompanied by medullation.* The factor of greatly varying fibre-diameter, especially when due to medullated fibres, has been the cause of outcry against New Zealand wools. The eradication of this defect presents a serious problem, the main difficulty being the exact cause or causes of the appearance of these medullated fibres. Sometimes they are in evidence to a greater extent in one year than they are in the next. Undoubtedly one of the predisposing causes is a genetic factor or factors. However, nutritional and climatic conditions appear to play their part.

It has been shown that medullated fibres are low in sulphur. It is therefore possible that there is some direct connection between these two factors. If there is a natural short supply of protein sulphur in the blood-stream, then it is likely that the larger-sized and quicker-growing fibres will be the first to suffer from this deficiency, and so produce

medulla. It may be that the low sulphur percentage in New Zealand grasses is one of the contributing causes of medullated wool and this may be remedied by manuring the pastures with ammonium sulphate. Some form of thyroid activity also may be a contributing factor. Until something more is known about the inheritance of medullated fibres, and what will be the effect of completely eliminating them from the fleece, it will be difficult to recommend any measures other than careful selection of both rams and ewes with desired type of wool from the flocks already existing in these districts and acclimatized to the conditions and sound breeding methods likely to prove effective in aiding the stud breeder to eliminate this defect.

(*b*) *Variation in diameter along the length of the fibre.* This defect is due to the presence of a medullated or thickened tip. In other cases it may be due to a period of semi-starvation, especially during the late winter and early spring periods, when there is considerable thinning of the fibres near the base. This is bound up with the question of genetics, and climatic and nutritional conditions soon after shearing. Some are of the opinion that the trouble is a hereditary one. From the manufacturers' point of view the trouble is important for three reasons, the first being that it may result in a larger percentage of noil to top, this being wasteful, the second being that the ends of the thickened fibre stand out from the manufactured cloth and give to it a roughened surface, and the third being that the medullated fibres mixed with ordinary wool appear to dye a different shade, so that uneven colouring usually results, which though useful in some cases is undesirable in others.

The eradication of this defect is not a simple matter because it is not confined to any one breed, and climatic and nutritional conditions cannot be easily controlled. However, a certain amount of selection by culling sheep that produce continuously and year after year too much thickened tip should be helpful in overcoming this defect. The aim of the breeder should always be to select stud sheep with even wool from tip to root.

(*c*) *Variation in fibre-length.* The problem of long and short fibres in the same staple is bound up to some extent with the defect of coarse and fine fibres occurring together, the coarse fibres being longer than the fine ones. From the manufacturers' point of view it means that there is an uneven behaviour of the fibres during the drawing and spinning processes which results in the final yarn not being as level and as smooth. Though this problem cannot be easily solved, an attempt could be made for improving matters by carefully examining the wool of selected sheep by drawing out the fibres in a sample of wool over a black background. There is no doubt that this type of fibre-irregularity is due in part to indiscriminate cross-breeding, which could be remedied by selecting a type suitable to a locality and keeping to it.

(*d*) *Fibres varying in size and shape without medullation.* The presence of irregular sized and shaped fibres in the same lock, even when they are not medullated, is another defect, which is one of the contributing factors in the production of harsh-handling wool and on account of which it is not possible to produce an even, flat-finishing yarn, so desirable for the production of most high-grade materials. It is necessary to endeavour to breed out this defect to as great an extent as possible.

(*e*) *Presence of kemps.* Wherever kemps occur in any flock, immediate steps should be taken, by selective breeding, to breed out the defect.

Harsh-handling wool

For this defect there are other contributing causes besides fibre irregularity—namely size and shape of the serrations or scales on the wool, dryness due to insufficient wool-grease, faulty dipping of the sheep, and in all probability, the plasticity and elasticity of the fibres. These factors, with the exception of dipping, probably are partly genetic and partly nutritional in character, and to a certain extent can be eliminated by selection for soft-handling wool and more regular feeding of the sheep. In carrying out the selection for soft-handling it may prove useful to scour samples of wool before judging them as in some cases the yolk has a tendency to mask

a moderately harsh handle. Where the benzol test is used for detection of medulla the 'handle' of the cleansed samples should be noted before they are placed in the benzol.

It has been shown that wools heavy in grease are better spinning wools than are those lighter in grease. This probably is due at least in part to the fact that the presence of the grease keeps the skin soft and prevents irregularities in the wool as it is pushed up through the openings of the wool-follicles. The wool-grease also plays a part in lubricating the wool fibres, and in doing so prevents the lifting by friction of the surface scales or serrations, with the tendency to produce a softer-handling wool.

Preliminary work on the influence of grease present in a fleece on the evenness or otherwise of the fibres produced and the spinning properties of the wool, has been commenced at Massey Agricultural College, but the trouble appears to be how to obtain a correct measure of the effects brought about by the lack of yolk, normal quantities of yolk, and excessive quantities of yolk in the fleece. It is also difficult to state how much of the trouble brought about by an insufficiency of yolk is due to lack of yolk secretion and how much is due to washing out of the yolk by heavy rains. There is also the question of what individual effects the two secretions present in the wool-grease—i.e. the secretion of the sweat-glands (suint) and the secretion of the sebaceous glands (wool-fat)—have on the wool fibre.

Faulty dipping causes soft wool to become harsh to the feel, especially towards the tip end. Climatic conditions also play some part in the production of similar harsh-handling wools. Soil conditions appear to have some effect, as some stud-sheep breeders maintain the impossibility of producing as soft a handling wool on limestone country as on a good friable loam.

Coloured fibres

(*a*) *In slipe* wools.* This is another fault of New Zealand wools especially in the slipe wools from the freezing works. As a rule the coloured fibres are brown or black owing to the influence of the Southdown and Shropshire sires of the fat lambs. This is where mutton and wool interests are in conflict, and it is a question whether it is an economic proposition to lose the early maturity and prepotency for carcass-shape of the Southdown in order to produce wool free from brown fibres. The most obvious way in which to combat the trouble without the fat-lamb producer being the loser would be to select and breed Southdowns with little or no face and leg colouring, and in so doing breed a strain of Southdowns with no coloured fibres. It has to be remembered that a white sheep is not an albino, but really is a coloured sheep in which pigment-formation is inhibited, and when rigid selection against coloured fibres wherever they are found is relaxed, coloured fibres, either individuals or patches, make their appearance. Since the coloured fibres in a Down cross fleece usually are concentrated near the extremities—i.e. legs and head—the freezing-works and fellmongeries probably could improve the grading of their slipe wools if they were to take care when 'pulling' the wool to place wool from these regions in separate lots.

* Wools removed from the skin of slaughtered sheep by the lime process.

(*b*) *In Romney-cross wools.* The trouble may be due to some trace of the English Leicester blood in the cross-bred, since with this breed black lambs occur fairly regularly, and, less frequently, black patches in the wool also may be found. This trouble should be eliminated by careful selection of the breeding stock.

Extraneous and deleterious matter

(*a*) *Jute and hemp fibres.* This defect may be due to either pieces of string, etc. picked up in a dirty shearing shed, or jute fibres from the wool bales. This defect can be remedied by a thorough cleansing of the shearing shed before and during shearing, carefully fastening the openings in bales and their proper handling and transport.

(*b*) *Burrs.* The burrs of which complaint chiefly is made usually are the seed-containers of the burr clover (*Medicago hispida*) but the burrs of burdock (*Arctium lappa*) may also cause trouble. These may be prevented by

the use of the hay-mower on grazing land at the time the plants are flowering.

(c) *Sheep-branding materials* that will not scour out, e.g. tar, paint, etc. The Wool Industries Research Association after great endeavour has partially succeeded in perfecting a new branding fluid that will remain visible on the sheep from shearing to shearing, and yet scour out, if not in the ordinary scouring-liquors, in a special piece-scouring solution. The trouble due to these materials is accentuated by farmers using linseed-oil, especially boiled oil, or turpentine to thin down fluids that are too thick. These dry very hard, and are extremely difficult to remove. If thinning is necessary, petrol or some other volatile spirit should be used for the purpose.

(d) *Pieces of skin left adhering to the wool.* This is due to the cutting of the sheep by the shearers and this trouble can be overcome by adopting a better standard of shearing. Improvement in this respect should permit of better economic use of the wool and less damage to the manufacturers' machines.

(e) *Pieces of hay, straw, etc.* These also cause trouble to the wool-manufacturers, as they are not always removed in the manufacturing processes, and a considerable amount of labour is entailed in examining the finished goods to pick out small pieces of fibre and in darning-up the holes. The sheep-farmer can help to improve this defect by seeing that his sheep do not have direct access to straw or hay stacks, and that any feed racks are so constructed that the sheep do not pull the material down on top of themselves. There is also a necessity for a more thorough cleansing of the shearing-shed to remove all chaff, straw, bird-nests, etc. before shearing commences.

Discoloured wool

(a) *Dead-yolk stain.* Its occurrence appears to depend chiefly on climatic and nutritional conditions during the growing season. As a general rule, true dead-yolk will scour quite bright and white unless accompanied by secondary affections.

(b) *Dip-stained wool.* Dip-stained wools not only have an unattractive appearance, but in some cases scour a bad colour, and in extreme cases the fibres may be damaged so that a bad spin results. The harmful dip-stains usually are brought about by improper mixing of dips containing carbolic derivatives, although arsenical dips also may cause the trouble.

(c) *Tick or ked stain.* Tick- or ked-stained wool is harmful chiefly because of its unattractive appearance, as the wool usually, but not always, will scour quite clean.

(d) *Coloured wools.* A number of coloured wools have been traced to the action of bacteria; blue, red, green, and yellow discolouration have been traced to this source. However, as the trouble usually is confined to small areas of the wool and to a very few sheep, it seldom is very harmful. Canary-yellow-stained wools, of which there appears to be a variety of types, however, probably are a more serious matter. Though the trouble does not appear to have any relationship to the dead-yolk discolouration, it appears as a secondary complication to dead-yolk in some cases. In the case of all canary-yellow wool, the actual wool fibres are dyed, and the colour does not scour out. Therefore any wool having this defect cannot be used for the white or cream goods trade, nor can it be used for high-class dyed goods. There are at least four possible explanations of the cause of the trouble, viz. bacterial action on wool-grease or the suint; chemical change in the colouring matter in the wool suint; the suint or sweat glands secreting a dyestuff elaborated in the body or extracted from some of the food that the sheep has eaten and lastly chemical interaction between remnants of a coal-tar dip left in the wool and the salts of the wool-suint, but so far it has not been possible to prove that any particular one is the causative agent. Hence control measures cannot be applied.

(e) *Baling of wool when it is damp.* The baling of wool when it contains excessive moisture causes heat to be generated, and when the temperature rises the wool may be slightly charred and show a brown discolouration. This discolouration is quite serious as the wool does not scour a clean, bright white, and trouble may also be caused by the

irregular dyeing of the damaged fibres. The heat generated also causes the wool to develop a tendency towards brittleness and harshness. Every endeavour should be made to see that the wool is not pressed too soon after shearing, and where possible, it should be left in the bins, as open as is practicable, to give it every opportunity to dry.

(*f*) *Discoloured slipe wools.* Slipe wools due to want of careful treatment show a tendency for a slight, and sometimes a marked, discolouration which may be accompanied by a harsh handle. This trouble probably can be traced to the sodium-sulphide and lime process used for removing the wool from the skins, and the subsequent use of acid to neutralize the lime. The use of either excess lime or acid is detrimental to the wool, especially when it is not completely washed out. It is therefore a matter of being particularly careful in all the processes of handling the pelts and wool so that as little damage as possible is done to the latter.

Ratio of length to spinning-quality

Yet another demerit of some New Zealand wools which the manufacturers have pointed out is that in some instances, especially with the finer three-quarter bred, Romney, half-bred, and Corriedale wools, such as 50s, 56s, 58s, and some 60s, there is a tendency to produce a wool that is too long for the spinning count. It might be pointed out here that cross-bred wool—i.e. wool other than Merino—is roughly classified into two classes with regard to length—(1) 'preparing wools' which are long, shafty wools usually 6 in. or more in length—but the length may depend to some extent on the count; and (2) 'carding wools' which are too short to go into the former class. If the wool is too long, there is excessive breakage, and therefore higher losses in the combing process, which means uneconomic production. It would be better to aim at a slightly shorter but denser wool, if the same quality must be kept, or else grow the same length but of a stronger quality.

Other factors

1. *Parasites affecting sheep.* One of the factors limiting the total production of wool, especially by young sheep, and a contributing cause of fibre irregularity, is the question of the effects on the general health of the sheep of such parasites as stomach, intestinal and lung worms, flukes, and to a lesser extent, ticks or keds, and lice. The latter also cause the sheep to rub against fences, etc. with resulting damage to the wool. The control of both the internal and external parasites by regular drenching and dipping with suitable parasiticides is, therefore, essential.

2. *Mycotic dermatitis* (or lumpy wool). This is a communicable disease of skin of the sheep, so far not reported in New Zealand, but found in various parts of Australia and South Africa, and it is characterized by the exudation of a wax-like material from the skin of the sheep, the exudation hardening to a substance not unlike soft horn, so that the wool is very unattractive, and in extreme cases it is not possible to shear the sheep.

Causes of deterioration

The probable causes are so many that only a few of them are given in their order of importance to show how really involved the problem is and how difficult it would be to overcome all of them.

The splitting up of the large estates has been a contributing factor since it has meant that sheep-breeding has passed into more hands, and some of the smaller farmers have not had much previous experience of either agriculture or stock-breeding. This has, in some cases, resulted in the partial deterioration of the foundation ewe flocks, while at the same time the small breeder thinks he is not in the position to spend extra money on purchasing good quality rams. With this should be grouped also careless breeding methods. It must be remembered that the small farmer who breeds fat lambs cannot afford to cull a sheep with a good carcass and which regularly produces good-quality lambs, no matter how bad the fleece may be. For this reason alone there will always be a certain proportion of bad wool produced in any country.

Another factor that has been instrumental in causing the production of some of the bad wool complained of is that of the natural

deterioration of some of the pastures. The fact that the dairy industry now monopolizes much of the good pasture land that produced originally much of the desired type of Lincoln and Leicester wools also comes under this heading, since it means a reduction in the general average quality of the pasture available for sheep.

The frozen mutton trade has resulted in many of the good ewe lambs being slaughtered, and cull lambs that have failed to fatten are held over and subsequently used for breeding purposes.

Wool improvement

The points that must be considered before any scheme of wool improvement is contemplated, are whether, if better wool is produced, that wool will prove as effective a protective covering as that we are producing at present, whether it will meet a ready and steady market, and whether the price received for it will be such that it is going to pay the farmer to produce this type of wool; also, whether the sheep that produces this wool will be as constitutionally strong and as equally efficient a mother for producing fat lambs. The question also arises as to whether the change in wool type will alter the supply of the different classes of wool in such a way as to unfavourably upset the present balance of supply and demand. There is also the question of what is going to be the supply of, and the demand for, fat lambs in the future, and what class of wool is going to be the most profitable to produce.

(*a*) *Breeding practices.* In no other country has wool improved so much as it has in South Africa There the credit for effecting much of this improvement is given to the work of the Sheep and Wool Extension Officers of the Department of Agriculture, whose duty it is to help the sheep-farmer in every way to improve his breeding practices, general management of the sheep, and the preparation of his wool for market. In New Zealand some at least of the present undesirable wool probably results from the indiscriminate cross-breeding that has been practised in the past. This indiscriminate cross-breeding has not been confined to crossing of different breeds, which, of course, is the worst type of cross-breeding, but also has included the crossing of different types within the same breed. If universal wool improvement is to be the aim, especially in New Zealand, then one of the first steps should be to demonstrate to the producer the necessity of selecting a type of sheep most suitable to his locality, and keeping to this type as near as is possible by selecting similar and, if possible, related rams each season. The present system of breeding with uncontrolled mating of the rams and ewes must lead to a mixed class of wool and sheep.

Both rams and ewes for the foundation stock should be selected on the basis of quality and quantity of wool produced. Rams of one particular strain should only be used so as to produce throughout the flock an even class of wool as free as possible from defects.

Some fundamental work, especially on the study of the inheritance of desirable and undesirable fibre types, is also needed. To obtain reliable results, probably the most satisfactory way in which to carry out this work would be to fix in small flocks one type of wool or peculiar characteristic by inbreeding, and consequent culling for a number of generations. When these sheep breed true for any particular character, cross-breeding of the different types will show which characters are dominant and which recessive.

(*b*) *Feeding and general management.* It is well known to most farmers that if a sheep passes through a period of semi-starvation, and later is well fed, during the period of shortage of food there is a diminution in fibre diameter. If this does not result in a definite break in the wool it will at least mean that the wool is tender, and in consequence not so valuable as is sound wool. What probably is the most necessary step to be taken in New Zealand at present is to endeavour throughout the year to even up and add variety to the food-supply of the sheep. By means of improved methods of grazing, and saving of hay or ensilage from the grass during periods of flush of growth, this can be accomplished. Such better feeding will not only result in the production of an evener-fibred wool, but should be helpful in improving the fat-lamb

production and in lessening the likelihood of the serious effects of parasitic diseases. Some careful feeding trials designed to determine the effect of various classes of foodstuffs, particularly those rich in and those lacking sulphur, on wool-production as regards both quantity and quality should be carried out. Along with this work there is the necessity for an investigation of the effect of various mineral deficiencies on wool-production, and the best method of solving the problems.

The need for greater care in dipping the sheep for the control of external parasites has already been stressed to a sufficient extent. There is little doubt that there should be some control of the dipping preparations sold in the country. What is required also is a dip that will not damage the wool and is capable of effectively dealing with both keds and lice at the one dipping, and so lessen the necessity for several dippings. The control of internal parasites is also of first-rate importance, so that sheep mortality may be reduced and production increased.

The presence of extraneous and deleterious matter in wool does not call so much for wool improvement, but rather for more careful management of the sheep and care in handling and preparing the wool for market.

(c) *Testing for production.* Dairy cattle, beef cattle and utility-purpose fowls have shown the most marked improvement in actual production during recent years. If the wool-producer is going to keep pace with the times, some form of measuring quality and quantity of the wool-production of stud sheep will be a necessity. Any system of wool-testing is going to mean the taking of samples for grease determination; and these samples also might be used for stating whether or not the wool contained irregular fibres. By this means it should be possible to sell rams with a certificate as to the quality and quantity of wool they produced, together with the records of wool produced by their sires and dams, and the general average of the flock.

Another aspect of testing work is that it introduces the element of competition and endeavour to do better. The result is that the whole system of management, especially in the direction of better feeding, is improved, and the better selection and breeding methods are employed.—*N. Z. Dept. Sci. & Ind. Res. Bull. No. 30* (Abstract).

New Books and Reviews

Farm Accounts in the Punjab, 1938-39
By Labh Singh and Ajaib Singh (Board of Economic Enquiry, Punjab, 1941, pp. 100, Re. 1-8)

ALTHOUGH agriculture is the premier industry of the Indian people, there are many vital questions on which we would like to have more knowledge. For example, we know very little about what the cultivator really earns after he has paid for the land, labour, capital and the wages of his own supervision; what is the net return on farms under canal, or well-irrigation, or dependent wholly on rain for maturing the crops? Where holdings are small, and they are usually so in the East, does a peasant-proprietor earn more than a tenant? Where the rent forms a part of the produce is it more advantageous to the landlord than if he had leased the land for cash or some other form of rent? We know very little as to how the farmer makes adjustments in his cropping and expenses when prices fall, and whether there is under-employment in the industry in both the manual and bullock labour. Is the income of the farmer in terms of daily wages more than what he pays his labourers?

An attempt to answer these and other similar questions is made in the *Farm Accounts* series of the Punjab Board of Economic Inquiry, the latest (fifteenth) issue of which, dealing with the year 1938-39, has just been published. This report summarizes the accounts of 29 holdings grouped according to the main agricultural tracts of the province. As in the previous issue, not only are the actual income and expenditure of the farms given but the accounts have been treated in a number of ways to arrive at the income if the holdings had been worked under different conditions. These are:

(1) Where the cultivator owns the land, labour and capital;

(2) Where he owns the first two items, but borrows the capital;

(3) Works as a tenant by taking the land on rent, borrowing the capital but using his own labour; and finally,

(4) Where the land, labour and capital are all borrowed, i.e. where the cultivator works as an entrepreneur.

To arrive at the profits from agriculture, proper accountancy methods are used, credit being given for droppings of animals used as manure, while interest and depreciation charges on implements, wells, cattle and cattle-sheds are debited under the relevant heads. Gross income includes the various harvest payments made in kind to menials, artisans, crop-watchers, *gur*-makers, etc.

The returns per worker (family and hired) are calculated per annum and per day, and analysed to show separately the income on account of management, labour and ownership of land and capital. Diaries are also maintained on the holdings to show the time spent on cultivation and on well-irrigation by the men and cattle, and the data reveal the extent to which agriculture employs the farmer and his cattle during the year.

As a measure of economy the accounts of individual holdings have been omitted in this issue except those of a large Government seed farm near Lyallpur, which has formed a part of the series since its inception in 1923-24. The information has, however, been summarized in tables which follow the discussion of results and show, separately for the irrigated and unirrigated areas, the amount of land put under each crop, the outturn and value; also the income and expenditure per acre, the return per worker, the shares of landlords and tenants in lands leased out on share-rentals (*batai*), and the proportion of land revenue to 'net assets' of the farms.

Since the 1928-29 issue the cost of irrigation from wells by means of various kinds of lifts has been included and in the present issue are shown the costs of 20 persian wheels worked by oxen, and 11 persian wheels and water-pumps worked by oil-engines and electricity. This information is of much topical

interest in view of the attention being given at present to the possibilities of the utilization of electrical energy in agricultural processes and of greater mechanization in this industry.

These *Farm Accounts* occupy a unique position in the economic literature of the country, presenting pioneer data, perhaps the only series of its kind in India. They also help to show how farm accounting should be done under Indian conditions.—(J. W. T.)

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The Scientific Photographer

By A. S. C. Lawrence, Ph.D. (Cambridge University Press, 1941, pp. 180, 18*s*.)

FEW of us have not at some time or other handled a camera, but how many of us do really know that photography is both a science and an art, that what matters most is not the clicking or the jabbing of the trigger but a keen appreciation of the various factors that make for good photographs? It is this knowledge of the technique of the subject that makes possible those classic photographs which stand out distinct from the mass of common mediocrity. Just these technicalities have been explained by Dr Lawrence with precision and lucidity. Not more than an elementary knowledge of physics and chemistry is required to understand 'the principles rather than the working details' with which the book deals.

We have a twofold task in photography: to know exactly what type of picture we wish to have and secondly to know how best it could be obtained. The first problem lies in the province of the artist who should call to his aid all his latent talents; the second requires the knowledge of the scientist. The scientist must know what photography can achieve. He must realize that the result depends on the choice of film, the nature of stop used and the time of exposure. The speeds of emulsions vary and are rated in different ways. Perhaps the most popular is the Scheiner method of rating them. But the figures mean little unless we have working knowledge of the films. It is not the speed only but the sensitivity to colour that also matters in the reproduction of a photograph conveying an idea akin to the original visual impression.

Plates and films are the raw material of photography but we must also have the 'camera obscura'. Any camera would do to take photographs, but what most of us need is a camera that will serve a variety of purposes—close-ups, portraits, landscapes and scenes of action. To decide our choice of camera we should know something about the lens, the shutter, and perhaps the speeds we expect to work with. Such attachments as range finders though not indispensable would undoubtedly help in obtaining more accurate results.

The advent of colour photography has increased immensely the range of action of the photographer. Kodachrome and Dufaycolor processes today give us the possibility of recording in colour what a few years ago we could only do in black and white or perhaps 'soot and whitewash'. Our interest in the subject mounts up with each such invention.

To the scientific photographer the technique of successful photography is mere child's play. The correct angle of view, the nature and direction of illumination, the time of exposure—these and several other factors are to be noted. We may be able to control some of them if not all. The choice of aperture is often fixed by the depth of focus required, but surely the time of exposure could always be controlled. Films certainly stand up to a certain amount of mishandling in this respect but they are not to be relied upon excessively.

Just as important as taking the picture is the processing of the film. Amateurs do not rely on their ability to do it. Even the scientific worker often thinks the trouble not worth taking. Developing is not a tedious task; on the contrary it gives one the chance of displaying that same initiative, that artistic touch which the professional processer never catches. There lies the great advantage.

In modern life the camera is almost indispensable. The ciné has revolutionized the problem of entertainment. But equally marvellous are the applications of the camera in other fields. Research in altogether new branches of science has been made possible by the use of the camera as a recorder—the

study of spectra, photomicrography, radiography, to name a few.

Dr Lawrence has given us an epitome of the subject in all its salient features. The inclusion of a few more working details would perhaps have added to the usefulness of the book. But it is none the less so for its absence, for the best guide to successful photography is, after mastering the theory of the subject, just experience. There the reader fills up the gaps.—(V. H. C.)

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Maharashtrantil Pani Purwata

By N. G. Apte, B.Ag. (Rajguru Press, Narayan Peth, Commonwealth Colony, Poona 2, 1938, pp. 194, Rs. 3)

THE book is a very useful publication on water-finding and has been written in Marathi. The author has treated the subject in its application, on scientific lines, to conditions in the Bombay-Deccan where, owing to inherent peculiar geological conditions, there is scarcity of water and therefore urgent need for locating underground water.

The subject-matter of the book is well arranged and discussed under nine main heads in a style and language which can be understood by literate cultivators. The discussion commences with an account of the geology of the Deccan Trap and of the influence of weather factors like temperature, rainfall and humidity on underground water supply. The conditions under which water can be found in the fissures of the solid rock are then indicated and finally an account is given of the uses of the 'waterfinder' instrument for locating underground water.

It is common experience in the Bombay-Deccan that many a well dug on the advice of the water-diviners has failed to find water and has resulted in loss of money and labour to the people. The author who has done extensive practical work on the subject has ably put together in this book his experience and the results of scientific study which promise to be of immense assistance to prospective waterfinders in sinking successful wells.

There is also an appendix to the book giving an outline of a scheme for development of tapping the underground water resources of the Bombay-Deccan which deserves the serious attention of everyone who has at heart the welfare of the people of Maharashtra.—(P. V. S.)

From All Quarters

HORTICULTURAL SOCIETY

AN all-India society of horticultural workers has been formed as from January 1942 with the purpose of advancing the cause of horticulture and horticultural sciences in India, by publishing a horticultural journal (Proceedings of the Society) and horticultural literature; by holding annual general meetings at the various horticultural centres, by rotation, and local meetings, and facilitating intercourse between members; by encouraging original investigation; and by organizing efforts to create facilities for horticultural work in the country. Membership is open to persons interested in any field of horticulture and horticultural sciences. The rules and constitution of the society will be similar to those of the other scientific societies in India. Pending appointment of the office-bearers by general election, an *ad hoc* Organizing Committee has been formed with the following personnel:

Dr G. S. Cheema, Horticulturist to Government, Bombay, Poona (Chairman); Sardar Bahadur Sardar Lal Singh, Fruit Specialist to Government, Punjab, Lyallpur; Mr A. M. Mustafa, Director of Agriculture, Baluchistan, Quetta; Rao Bahadur H. C. Javaraya, Director of Horticulture, Mysore State, Lal Bagh, Bangalore; Dr V. R. K. Badami, Deputy Director of Agriculture, Orissa, Cuttack; Khan M. Aslam Khan, Agricultural Officer, N.-W. F. P., Peshawar; Mr S. S. Bhat, Horticulturist to Government, Baroda State, Baroda; Dr H. K. Nandi, Economic Botanist to Government, Assam, Jorhat; Mr M. R. Fotidar, Director of Agriculture, Kashmir and Jammu, Srinagar; Dr S. Hedayetullah, Economic Botanist to Government, Bengal, Dacca; Thakur R. S. Singh, Superintendent, Government Gardens, Lucknow, U. P.; Mr K. C. Naik, Fruit Specialist, Madras; and Dr P. K. Sen, Horticulturist, Bihar, Sabour (Secretary).

***

DEATH OF WORLD'S OLDEST COW

THIRTY years ago a cow of the Ayrshire breed was exported to Australia from Scotland.

She had a calf named 'Victoria', and this animal has just died at the age of twenty-nine years, the greatest age ever recorded for a milking cow.

At eighteen years of age, when she was bought by Messrs Korff Bros., of Campbelltown, New Sydney, she produced 15,595 lb. of milk and 473·35 lb. fat. Two years later she was champion at the Sydney Royal Show, and even at the age of twenty-four, when she won second prize, she gave 13,313 lb. of milk and 542 lb. fat.

'Victoria's' only son, 'Glengowan Victor', born when she was twenty years old, has sired some of the greatest milk producers in Australia, while a daughter of hers, 'Glengowan Joyce' held the Australian record as a two-year-old, producing 53,433 lb. milk and 2,296·9 lb. fat in four lactations each of 273 days.

***

The Agricultural Officer, Baluchistan, will hereafter be called Director of Agriculture, Baluchistan.

MGIPC—M—III-1-5—14-5-42—2,000.

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INDIAN FARMING

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Vol. III JUNE 1942 No. 6

RYOTS TO THE RESCUE

Then it's Tommy this, an' Tommy that, an' 'Tommy, 'ow's yer soul ?'
But it's 'Thin red line of 'eroes' when the drums begin to roll.

—Rudyard Kipling

ABOUT three months ago a certain industrialist spokesman said: 'Nearly 70 persons out of every 100 have no higher occupation than agriculture or services dependent on agriculture.'

The remark was unfortunate. Whatever else war does, it focusses attention on the absolute necessity for a strong national agriculture as a basis for every other action.

One might say to the industrialist that, if the army marches on its stomach, industry does so in a double sense. The hunger of the factory worker and the hunger of his machine (for raw material) have both to be satisfied by agriculture.

In comparison with many other countries, India is to a considerable extent self-sufficient as regards her food supply in normal conditions. But the present conditions are not normal. The cessation of the supply of Burma rice to India (which was of the order of 1½ million tons per annum) is enough in itself to demand an immediate drive to increase, within India, the production of this staple cereal. The wheat position some months ago gave rise to anxiety, but late rains made a considerable difference. Nevertheless, even with a normal wheat harvest the lack of carry-over and the large demands make the increase of this cereal also of the first importance.

An increase of the total food supply by increasing all important food grains is a step towards generally easing the situation. If one type of food grain is in short supply and dear, then another, which is in larger supply and at a more reasonable price, may be bought and used instead. The other important food grains in India are *jowar* and *bajra*, maize and gram. In certain parts of India, the small millets also play an important part.

The food production drive, which is now in full swing, has been the subject of much thought and discussion. Public interest was evinced in the problem several months ago in letters to the newspapers and in leading articles. The Advisory Board of the Imperial Council of Agricultural Research gave the matter its attention and passed a comprehensive resolution regarding it. The Wheat Committee also considered the problem and made several useful suggestions. Finally, the Government of India called a conference of representatives of provinces and states from the whole of India to discuss the matter and advise on immediate practical measures.

This Conference met on 6 April. The opening address then given by the Hon'ble Member for Education, Health and Lands—Mr N. R. Sarker—is printed in this issue. The conference passed a series of resolutions most of them indicating lines of action that could be taken up at once. In addition, the Government of India indicated its willingness to step in, if necessary, and buy food grains

if this action were desirable in order to prevent a slump in prices to the grower.

The main conference was followed up in the next two days by informal discussions between the officers of the Government of India and the visiting representatives of provinces and states. Valuable information was exchanged as regards the actual measures already being taken and the preparation of an estimate of what these measures were likely to produce in the way of increased food in the following *kharif* and *rabi* seasons. Given favourable climatic conditions it was hoped to increase the area under food grains by 70 lakhs of acres producing 17 lakhs of tons of extra food grains.

The following are some of the propaganda measures that have already been put into action by certain provinces or states:

(i) Remission of land revenue for one year on land where cotton is replaced by food crops (Central Provinces);

(ii) Reduction of irrigation charges for certain crops (Bombay, Madras, United Provinces, Hyderabad, Mysore, Indore);

(iii) Restriction on irrigation of short-staple cotton (Bombay, United Provinces);

(iv) Supply of seed or manure or both at special rates (Assam, Bengal, Bihar, Madras, Punjab, Baroda, Hyderabad, Mysore);

(v) Guarantee of minimum price (Baroda has done this for *bajra*, and Indore for wheat);

(vi) *Taccavi* at usual or special rates.

In the main conference and also in the following discussions, the all-India aspect was prominently stressed, particularly with regard to the need to make arrangements for the feeding of areas which even in the best of years are in deficit with regard to food grains. In other countries this equality of sacrifice is obtained by rationing which, at the moment of writing, is not being applied in India.

We have no doubt our readers are all out to do what they can on the food front. In addition to the efforts that they themselves are making, they may be able to help by letting others know of their ideas and experiences. INDIAN FARMING will be glad to consider for publication helpful communications of this kind.

SCIENCE AND A NEW WORLD ORDER

SCIENCE pools knowledge from every quarter and offers to the man of today a vast accumulation of well-ascertained facts drawn from its many branches of discovery. It strives to seek absolute Truth, not utopian theories. But till the goal is reached, in the interim, in a world torn by conflicting ideas and 'isms, Truth is true only in relation to its contexts. The precision tools, the alloys, the specialized steels perfected by scientific research can be used equally well in the making of surgical instruments, in improved ploughshares, in drills for cutting the hardest rock as well as in the making of a super-edge sword, a *Messerschmitt* engine, or in the internal mechanism of a death-dealing bomb. To check this perversion of science, it is time the hierarchy of pure science asserted its patent rights on the common pool of strategic science and, backed by its one and a half centuries of resolute strivings for the betterment of mankind, claim a determining share in the governments of the world.

We live today in a quick-changing world. Signs of a new world order are dimly apparent on the horizon. A new democracy—the democracy of science and altruistic knowledge—is emerging, pledged to do away with the 'war potential' from human society. Success may not be immediate, but there is no doubt that Man, with his centuries of struggle and conflict, is evolving. Conflict has a place in the working of the physical universe, but it is a passing phase and out of conflict comes order and evolution both in the organic and inorganic world. The poet's dream 'In the Parliament of man, the Federation of the world—When war drums throb no longer and the battle flags are furl'd' is perhaps nearer realization than it ever was in the past.—D. N. Wadia, *General Presidential Address, Indian Science Congress, 1942.*

Original Articles

THE FOOD FRONT*

By The Hon'ble N. R. Sarker

Member for Education, Health and Lands in the Government of India

WE are assembled here today to deliberate on a problem of supreme importance to the maintenance of the peace and contentment of the civil population in the fateful days that lie ahead of us. Even in peacetime a healthy, well-balanced and flourishing agriculture is regarded as a vital element in a nation's well-being. But during war, agriculture is called upon to play a far more important role, that of feeding the entire civilian and military population under conditions of great stress and strain with the object of maintaining their morale. In fact, if an army marches on its stomach, the morale of a nation in war depends upon its food supplies. A well-considered policy in reference to food production is, therefore, an integral part of successful war effort.

Unprecedented situation

The food situation with which India is confronted today is unprecedented. There have been food shortages in India in the past, sometimes amounting to famine, in areas large and small. They were due mostly to the failure of the monsoon, but never before had we a food shortage quite like the present one, either in respect of its causes or its character. During the last war, the food situation did not assume any serious proportions until near its end and the two succeeding years, and it had a reassuring feature in that we had uninterrupted access to Burma rice and our internal transport difficulties were less acute than what we have to contend with now.

As you are aware, in the supply of her requirements of food, India has to obtain in normal times fairly large quantities of rice from Burma and at times also import some wheat from Australia. The virtual cessation of rice imports from Burma has caused an appreciable gap in the total supply of rice for home consumption. With the growing demand for wheat, for which also we have to depend now on our own resources, India is faced with a shortage of supply. As these two main staple articles of diet are short, the public is increasingly consuming other foodstuffs, such as barley, *bajra* and *jowar*. The result is that there is a sharp rise in their prices also. The task before us is to formulate a practicable programme of action to meet the threatened shortage during the war, particularly in the next twelve months or so.

A 'Grow More Food' campaign must, for obvious reasons, be based on a clear appraisal of the latest statistical position of the staple food grains which are produced in India for domestic consumption. Such an examination would not only reveal the true position in regard to individual food grains but also furnish a quantitative basis for planning the programme of increased production of particular crops under the proposed campaign.

A comprehensive survey of the position of all food grains bristles with difficulties, but for the purpose of this conference it will, I think, suffice if it is confined to the four important crops, viz. rice, wheat, *jowar-bajra* and gram, which, between them, account for about 80 per cent of the total production of food crops in India estimated at a normal average of about 600 lakh tons. Their respective shares are 265, 102, 92 and 35½ lakh tons a year.

Normal self-sufficiency

In normal years, India is self-sufficient in respect of her food requirements except for rice which she has to import from Burma to

* Address delivered to the conference of representatives of provinces and states at New Delhi on 6 April.

the extent of about 14 lakh tons a year, which represents a little over $5\frac{1}{4}$ per cent of the total rice production and about 2·3 per cent of the total food production of the country.

The position in which India stands at this moment in respect of her food supply, however, is very different from the normal. This change, as I have mentioned, is due mainly to two factors: firstly, the cessation of imports from outside, and secondly, the difficulties of transport, and the possibility of even a dislocation in transport within the country. I shall make a rapid survey of these altered conditions in respect of the four principal crops I have just mentioned. I trust it will be of some help to you in appreciating the problem of imminent food shortage with which India is confronted.

Rice and wheat

Let me take first the case of rice, which is by far the most important and extensively grown food crop in India. The average production of rice is 265 lakh tons. This, however, does not meet the requirements of India in full and has to be supplemented by imports from Burma to the extent of about 14 lakhs of tons every year.

In the current year, however, the position in regard to this crop has seriously deteriorated. The internal production has declined by about 9 lakh tons, despite the fact that the crop in Bengal and Madras is much larger than normal this year. It is apprehended that this short crop coming on the top of cessation of imports from Burma will increase the net deficit of India's supply of rice to the tune of nearly 23 lakh tons on the basis of normal consumption. And we have further to take into account some other abnormal factors. Even if there may not be any large demand for rice for military purposes, we shall have to meet a larger demand from Ceylon, which so long was mainly dependent on Burma for meeting her deficit.

The position in regard to wheat is also unsatisfactory. Normally the yield of wheat in India is 101·6 lakh tons, of which about one-third is accounted for by the Punjab, which along with central India, Sind, the Central Provinces and the United Provinces have a surplus of about 9·11 lakh tons—the Punjab alone accounting for 5·45 lakh tons of wheat and 1·28 lakh tons of wheat flour—against an estimated normal deficit of 7·31 lakh tons of other provinces and states. In normal years India would thus appear to have a net surplus for export and other requirements.

In the current year the position has deteriorated a little, the output being estimated at 100·5 lakh tons. The Central Provinces, instead of being a surplus area, will be heavily in deficit this year. I am glad to say, however, that according to the latest information it appears that the production in the Punjab and in the United Provinces will be practically normal. Sind, central India and Bihar will have an exportable surplus of 119,000, 94,000 and 24,000 tons respectively. From information so far available the net deficit will be, taking into account extraordinary demands, of the order of 3·5 lakh tons.

Jowar-bajra *and gram*

Unlike rice and wheat, *jowar-bajra* does not present the picture of a net deterioration from an all-India standpoint, although figures of the year's production are not yet available. The normal production of *jowar-bajra* in India is 92 lakh tons, the amount available normally from the surplus areas, which comprise the United Provinces, central India, Sind, Mysore and Hyderabad, being estimated at 1·89 lakh tons, against the estimated requirement of 1·54 lakh tons of the deficit areas. In other words, India has normally a small surplus of these crops.

The latest reports tend to show that in some of the important consuming areas the position is not quite satisfactory. The Central Provinces, for instance, reports a shortage of one lakh tons, Bihar of $\frac{1}{4}$ lakh tons, while Hyderabad is threatened with a shortage of $2\frac{1}{2}$ lakh tons, against the usual nominal surplus of 2,000 tons. These are, however, offset by a reported excess of $1\frac{1}{2}$ lakh tons in the Punjab and $\frac{3}{4}$ lakh tons in the United Provinces, and taking an all-India view, it may be said, broadly speaking, that the production of the year is not much below average.

In the case of gram the latest figures are not available. The normal production of this

crop is 35½ lakh tons, the chief producing areas being the United Provinces followed by the Punjab and Bihar. It is estimated that the amount obtainable from surplus areas is about 3·01 lakh tons against the total requirements of 2·97 lakh tons from the deficit areas, mainly Madras, Bombay and Bengal. Regarding the current year's crop, the latest information received from Bombay, the Central Provinces and the Punjab, of which the latter had the largest exportable surplus in normal years, shows that the production in these provinces is normal. Bihar has a surplus of ½ lakh tons but the United Provinces expects a shortage of over 3 lakh tons. Nothing extraordinary has been reported from other provinces and it appears that there will be a shortage of this crop of about 2½ lakh tons.

I have attempted to present before you a bird's-eye view of the position of the principal food grains in the country as a whole, but to make the picture more complete and more helpful in arriving at practical conclusions for drawing up our plan of action, I propose to supplement it by an appreciation of the position in each province separately. I may mention here that there are no comprehensive data regarding the surplus-deficit position of the provinces and states in respect of their total food requirements. A reliable indication in this respect is, however, provided by the river and rail-borne trade statistics duly correlated to production statistics. Some estimates of the general position of each province and state have been prepared on the basis of average production figures for the years 1936-37 to 1938-39 and average rail and steamer traffic figures for the years 1937-38 to 1939-40, and they will be circulated to you. I am, however, indicating here only a few of the conclusions which these statistics reveal.

Surplus and deficit

Of the provinces, Assam on the north-eastern frontier and the North-West Frontier Province on the north-western are normally more or less self-sufficient. In the current year, the position of the North-West Frontier Province is, if anything, slightly better than usual and no imports are likely to be needed, except of a small quantity of rice. On the other hand, in Assam there is in the current year a deficit of 324,000 tons of rice. This deficit, however, can be met partly from old stocks, and it appears that it will not be necessary to import more than 1½ lakh tons from the unusual surplus of rice in Bengal during the current year. To some extent the strain on the transport system can be avoided by using country-boats wherever possible. The military situation may also necessitate a sudden increase in the demand for food crops in these two normally self-sufficient frontier provinces.

In surveying the provincial situation, we should do well to bear in mind these contingent factors and accordingly provide for a margin of security in our immediate crop-planning.

Of the deficit provinces, Bombay and Madras are the most conspicuous. Normally the deficit in respect of food crops in Bombay is of the order of 8½ lakh tons—consisting of 4·8 lakh tons of rice, 2·4 lakh tons of wheat, 0·7 lakh tons of gram and ½ lakh of *jowar*. In the current year, however, the production of rice is 3 lakh tons below normal, and so the total deficit is raised from 8½ lakhs to 11½ lakhs of tons, assuming other crops to be normal. In Madras, on the contrary, the production of rice is 5 lakh tons above normal and this reduces the total deficit in food crops in the province from 9½ lakh tons to 4½ lakh tons. The deviations from the normal in these two neighbouring deficit provinces are thus in the contrary directions. They are to that extent compensatory and useful in easing the situation.

Serious deterioration

Next we come to the Central Provinces and the United Provinces. These two are normally among the surplus provinces. But their position is reported to have seriously deteriorated during the current year. Normally the Central Provinces has a surplus of 2 lakh tons of rice, 23,000 tons of wheat and 20,000 tons of gram and a small deficit of 7,000 tons of *jowar-bajra*. During the current year, however, the production of rice has gone down by 10 lakh tons, of wheat by 2·4 lakh tons, of *jowar-bajra* by almost 1 lakh tons. The net result is that the Central Provinces from

being a province with a net surplus of over 2 lakh tons food grains, is faced in the current year with a deficit of over 11 lakh tons. It is hoped to meet part of the rice deficit from old stocks. Among the provinces, the position of the Central Provinces appears to have most seriously deteriorated.

The normal position in the United Provinces is that it has to import 2 lakh tons of rice, but has a surplus of wheat, *jowar-bajra* and gram aggregating about $2\frac{1}{2}$ lakhs. In the current year, the production of rice is lower by 4·3 lakh tons, of gram by 3 lakh tons. On the contrary, *jowar-bajra* has yielded 70,000 tons more. The United Provinces thus, from being a net surplus province, has run into a deficit of $6\frac{1}{2}$ lakhs. It is to be noted that while the position of *jowar-bajra* has deteriorated in the Central Provinces, it has almost to an equal extent improved in the United Provinces and to that extent, the situation is eased. In respect of rice, however, the position has deteriorated heavily in both the provinces and they cannot lend a helping hand to each other, but must look to help from other provinces, such as Bengal or Orissa. The Central Provinces may also have to import wheat from the Punjab, or from Sind or Bihar, which have an improved wheat position during the current year.

Surplus rice in Bengal

Now we come to the two deficit provinces of Bengal and Bihar. Bengal normally imports to the extent of 64,000 tons of rice, 240,000 tons of wheat and 38,000 tons of gram. Bihar, on the other hand, has normally a deficit of 1·9 lakh tons of rice, and a deficit of 38,000 tons of wheat, but has a surplus of 20,000 tons of gram. Owing to the extension of rice cultivation in areas released from jute, and favourable weather, the rice deficit in Bengal has been converted into a large surplus of about $13\frac{1}{2}$ lakh tons. Bengal will thus be in the fortunate position of being able to supply rice to the contiguous provinces of Bihar and Assam which have run into heavy deficit in this respect during the current year. We find that while these provinces have normally a net total deficit of about 3 lakhs and 2 lakhs tons respectively, Bengal's deficit of food grains has been converted into a surplus of $11\frac{1}{2}$ lakh tons during the current year, while Bihar has a deficit of 5 lakh tons of rice, which is to some extent set off by a surplus of half a lakh tons of gram. Its wheat position has improved but that in respect of *jowar-bajra* has deteriorated by $\frac{1}{4}$ lakh tons each.

Lastly, we have the three provinces of the Punjab, Sind and Orissa, which are normally heavy surplus areas and whose position has not been affected seriously in an adverse sense during the current year. The Punjab is normally more or less self-sufficient in respect of rice, while Orissa and Sind have a big surplus of 1·8 and 1·5 lakh tons respectively. The rice position has worsened during the current year in all these provinces; while the Punjab will need about 19,000 tons of rice, the surplus in Orissa and Sind has fallen to 40 and 60 thousand only. As regards other crops, the normal position in the Punjab is that it has a surplus of $5\frac{1}{2}$ lakh tons of wheat in addition to $1\frac{1}{4}$ lakh tons of wheat exported as flour. It also exports 1 lakh tons of gram but has to import 15,000 tons of *jowar-bajra*.

In the current year earlier reports showed a shortage of nearly 3 lakh tons of wheat, but the latest information is, as I have already said, that the position will be practically normal in respect of wheat and gram and there will be a surplus of 1·48 lakh tons of *jowar-bajra*. On the other hand, Sind's normal surplus of 50,000 tons of wheat has increased this year to 119,000 tons. Sind's surplus of 20,000 tons *jowar* is balanced by a deficit of 16,000 tons of gram. Orissa normally imports 9,000 tons of wheat, but is practically self-sufficient in gram. The food crop position in these three provinces is normal during this year, with the exception of wheat in Sind and rice.

I have not been able to obtain full detailed information regarding the Indian states. Hyderabad is deficit in rice and to a small extent in wheat, but has a small surplus of *jowar-bajra* and gram. Mysore is deficit in all food grains, except *jowar-bajra*, while Rajputana is heavily deficit in all food grains, excepting gram. Central India has a considerable surplus of wheat, *jowar* and gram, but has to import 14,000 tons of rice. On the

whole, the position does not seem to be serious, except that Rajputana's total deficit of 135,000 tons of food grains must be met from outside as there is little scope for increasing production there.

Strain on transport

This analysis of the position in respect of the main food crops brings out that we shall have to face a deficit of 23 lakh tons in rice without taking into account the requirements of Ceylon (except to the extent to which the situation can be met from old stocks) and 3½ lakh tons in wheat which in turn will cause heavy pressure on other foodstuffs. The position has been further aggravated by the fact that a very heavy strain has been placed upon the transport system of the country. As a result, the quick transportation of foodstuffs even within the country has been rendered difficult. When further we take into account the possibility of a dislocation in the transport system, the seriousness of the position becomes obvious. In view of all these considerations as well as of the fact that we can no longer depend upon imports to make up any abnormal deficit in our production owing to vagaries of the season, it is, I think, incumbent that a forceful drive should be given to increase production of our food crops to the utmost in every part of the country. I need hardly point out that unless we take energetic and speedy action in time, the growing food shortage is likely to create a situation which will have grave and widespread reactions on social peace and order which, in its turn, would seriously impede the war effort.

India is a vast country. Traditionally each province and state has specialized in the production of certain specific crops suitable to its climate and soil and has depended for its requirements of foodstuffs, either not grown at all or produced in insufficient quantities, on other provinces which produce them. Such specialization naturally means that while, generally speaking, particular provinces or states have a surplus in respect of some food crops, they have a deficit with regard to other foodstuffs which is met by the surplus from the provinces which specialize in their production. The most fruitful line to pursue, in my opinion, would be to proceed on the basis of such surplus—deficit position in respect of food requirements of each province and state.

Our first and foremost objective should be to see how far deficits of some areas are met by actual or potential surpluses of others, and to estimate the net shortage in respect of each commodity such as rice and wheat in the country as a whole. On the basis of such estimates of the net shortage, we can explore how far different provinces can increase the area under those particular crops and also increase the output otherwise to make good the total net deficits. In my view, the provincial and state Governments would be in a position to launch a vigorous 'Grow More Food' campaign in their respective areas, on the basis of these shortages, which will indicate the objective standard to be attained.

Apart from the necessity of organizing a 'Grow More Food' campaign adequately to meet the total demand for foodstuffs in the country, the provincial and state Governments would also have to examine carefully whether, in working out plans to expand the area under the 'deficit foodstuffs', they can aim at some degree of regional self-sufficiency as a safeguard against possible interruption in the transport system of the country.

Regional self-sufficiency

What I have in my mind in regard particularly to any deficit in the total requirement of any food crop will be clear from one illustration. It is common knowledge that the country will be faced with an absolute shortage in the total supply of rice. Having ascertained the net deficit of rice in the country as a whole, it would be necessary to explore how far the production of the crop can be increased in different areas, in the light of their climatic and soil conditions in the coming season. Any programme that may be drawn up for the purpose will then have to be put into operation on a coordinated basis backed by an intensive and planned effort on the part of provincial and state Governments. Should it be found that the net shortage cannot be completely made good, then, other questions such as substitution of that commodity by surpluses

of other foodstuffs will have to be taken into account.

If all such measures fail to fill up the gap completely, then, it would be for the various Governments to consider how far an all-round cut in the consumption of that commodity must be voluntarily accepted by all the provinces and states. In such a contingency, I am afraid there may be a tendency to ban exports from one unit to another. Such a policy, examined in the background of larger and ultimate national interests, would be extremely short-sighted. Although I have incidentally referred to economic self-sufficiency as an objective, I have done so only with the object of providing an incentive to increased production and in the special circumstances in which communications may be interrupted or dislocated. My intentions are far from supporting the ideas of a narrow economic nationalism.

The objective which I have mentioned necessarily implies that there should be some purposeful and deliberate planning on the part of the authorities concerned with agriculture. At the moment, however, our main concern is not to contemplate any long-range plans but to address ourselves to the immediate task of expanding area and output of foodstuffs which are deficient in supply in the country as a whole. The problem is indeed one of short-term crop planning, which should embrace in the first instance a three months' plan for the ensuing *kharif* crops and another fifteen months' plan for the next season as a whole.

There are some special features in the conditions of agriculture in India that make the proposed planning of crops for short and intermediate terms a practical proposition. Even in respect of the existing cultivated lands it is found from past experience that the acreages under particular crops widely vary in some cases from year to year. Only in some exceptional instances, as in the case of jute, is this variation attributable to the initiation of a policy of crop control. In all other cases the variations in acreage are due to the effect of prevailing prices and climatic conditions and the net economic advantage obtainable from the cultivation of a particular crop, as compared with other alternative crops. The extent of this variation is considerable and even in the case of a staple crop like wheat it is found to be more than 12 per cent measured by the difference between the actual maximum and minimum acreages during the past decade.

Taking individual deficit provinces this difference is found to be much larger than the percentages calculated on all-India figures. Thus the acreage under wheat in Bombay has varied during the past decade from a minimum of 1·65 million acres to 1·92 million acres, representing a difference of 16 per cent. On the same basis of calculation, the acreage under rice in Madras varied by 22 per cent, by more than 15 per cent in Bombay and about 30 per cent in the United Provinces. These facts would clearly show that the problem of short-term crop planning which is called for by the 'Grow More Food' campaign is essentially a problem of redistribution of acreages under different food crops. It is not conditioned by any expensive capital schemes for increasing cultivable lands by reclamation and drainage and such other processes which do not allow scope for quick action.

Crop planning

There are some other factors that favour the initiation of short-term crop planning, viz. that a considerable proportion of lands in India is suitable for growing a variety of crops and that the loss of export markets during the war in respect of short-staple cotton, to cite an example, must force a curtailment of some of the commercial crops and release lands of which a portion at least should be available for the production of food crops. Thus, in India, the problem of short-term crop planning would involve, apart from intensive cultivation, the transfer of some lands from crops of doubtful economic advantage to the cultivation of food grains, and possibly to some extent the bringing of some sub-marginal lands under cultivation which again would not entail any extraordinary financial commitment on the part of cultivators. Facilities for drainage and irrigation, where necessary, will, I hope, be provided by the respective provincial or state Governments.

Having ascertained the position in respect of the deficits of the foodstuffs that are to be

made good, our next objective would be to examine the ways and means of putting the plan into action. Great reliance must be placed on vigorous and effective propaganda. The education of the cultivator must be an important plank in our programme. It should be explained to him that as the export market has disappeared, production of crops like short-staple cotton should be curtailed. Instead, he should now grow more food. As for propaganda methods, I have seen some pamphlets issued by the Bombay Government, which greatly impressed me. These pamphlets may, I venture to say, be emulated by others with benefit. I need hardly stress that this propaganda should be backed by all official and non-official agencies capable of rendering any assistance in the furtherance of the plan.

Minimum price guarantee

It may be urged that propaganda by itself may not be sufficient to induce the cultivator to grow more food crops. The question of guaranteeing a minimum price becomes in this context a pertinent one. I may, however, say that the question does not appear to me to involve any serious financial implications in the present conditions of limited supply of food grains. The creation of imports has already reduced the hitherto available normal supply. At the same time, we are faced with a much increased demand owing to the exigencies of war. In the circumstances, there need not be any apprehension of a serious fall in the prices of food crops, even if their supplies should somewhat increase as a result of the 'Grow More Food' campaign. In fact, with most commodities, the problem has of late been one of controlling prices rather than that of guaranteeing a minimum.

Although, therefore, I do not foresee a situation, at least in the immediate future, where food prices are likely to suffer a debacle, I recognize that some minimum price may have to be guaranteed with a view to assuring the cultivator against such a contingency. What the guaranteed minimum price will be is under the consideration of Government. It is sometimes urged that it should be a fair and economic price. I do not wish to enter into any controversy as to what should be considered a fair and economic price. But I would like to say that in considering what the guaranteed minimum price should be, Government will be guided for the most part by the trend of prices prevailing during the last few years. The main object in guaranteeing a minimum price is to protect the cultivator under all circumstances against a catastrophic fall in prices in the unlikely event of over-production as a result of this drive.

It appears on the information available that the stock position of the different crops is not at all strong. On the contrary, it may be, as in the case of wheat, weaker now. The present time is not therefore opportune to build up stocks, as such a course may react adversely on the available supply. The question of building up such stocks in different parts of the country should, therefore, wait until we have a clear idea of the results of our campaign. I hope you will agree that hoarding at the present time by private consumers or middlemen should be discouraged.

Coordinated action

A food production drive is primarily the responsibility of provincial and state Governments. It is their duty to devise effective ways and means to induce the cultivator to grow more food, and thus ensure the success of this campaign. But in view of the present abnormal conditions as well as to ensure coordinated action in the execution of the plan, the Government of India consider that they may render them some assistance in this matter. They have under their consideration the question of guaranteeing a minimum price with a view to assuring the cultivator against any catastrophic fall in prices, and also setting up a central organization for the pooling and dissemination of information.

I also suggest for your consideration that this opportunity should be taken for inducing our people to grow vegetables and fruits on waste or unused lands in or near their homestead. This will not only insure them against shortage of staple foods, but also enable them to have a more balanced and nutritive diet.

The problem that confronts the conference is as urgent as it is formidable. I have explained, in broad outline, its nature and put forward

certain suggestions to the conference for evolving a suitable plan of action. But the success of any plan that may be evolved will, in the main, depend upon a proper and effective organization to translate it into practice. I would mention in this connection that many other countries in the world have bestowed serious thought on the question of agricultural planning in the recent past and have set up appropriate machinery for giving effect to their plans. Since the outbreak of the war, Great Britain has intensively carried out the 'Ploughing-up' camapign through the County War Executive Committees, with a view to expanding the total available food supplies at home. Similar efforts have been made in America, Russia and other countries and I need hardly dilate upon them. These instances clearly reveal that the success of such a plan very largely depends on constant attention of experts given to it, and I strongly feel that for the scheme that may be evolved, it would also be necessary to set up an appropriate organization.

I would suggest, for the consideration of the Conference, that each provincial or state Government or group of such Governments should immediately set up suitable advisory committees and appoint a regional officer and necessary staff to organize the 'Grow More Food' campaign. Apart from these regional organizations in each province, I should think a Central Food Advisory Council should be established to pool together and disseminate information as well as to advise on an all-India basis food and fodder production programmes for different regions. While the function of the regional organizations will, in the main, consist of executing the plans, with the help and cooperation of non-official agencies in the respective areas, the central organization can serve as a clearing house for information and effect adjustments in the regional plans from time to time.

I am fully aware that in most provinces and states which are represented here today a great deal of thought and attention has already been bestowed upon the question with which we are concerned. I should, however, like to stress that the times through which we are passing are so grave and the magnitude of the task that awaits us is so great, that coordinated action on the part of the provincial and state Governments, through the agency of the Government of India, is very essential at the present juncture.

Appeal for cooperation

Before I conclude my address, I would make two observations. Time is the essence of the matter and a heavy responsibility rests on all concerned to see that we come to grips with the problem and evolve and execute a well-thought-out plan with speed and energy at the earliest possible moment. While emphasizing the role of the central, provincial and state Governments in the achievement of the task which lies before us, I would make an earnest appeal to the general public to give its unstinted cooperation in its fulfilment. The official organization which I have outlined can only serve as a nucleus, but I envisage that round this small nucleus will grow a large number of committees, consisting of the leaders of public opinion, which would extend from the capital city of the province down to the small villages and thus reach the cultivator. The question of increased food production has already received careful attention at the hands of non-official bodies in the country. Now that the conference will be deliberating on this vital problem and making recommendations for immediate concerted action, I hope and trust that the public and its leaders will offer their generous cooperation in all the practical measures that would be devised for rousing and stimulating the ryots to grow more food crops.

We are today facing a crisis, which in time may grow even more acute. It has, however, brought out in full the true significance of agriculture in a national economy, particularly during war. It is now for you to formulate a plan and execute it so as to ensure adequate supplies of essential foods to the people of this country, whatever may befall. For in war food is the most fundamental and decisive factor. All of us who are assembled here have a great part to play in the critical times which lie ahead of us. If we do not fail in this emergency, our contribution to final victory will not have been unworthy or insignificant.

ESTATE FARMING IN INDIA

IV. THE MILITARY FARM, OKARA

By Lt.-Col. A. H. Scrivener

Officer Commanding, Military Farm, Okara (Punjab)

THIS estate, comprising 22,040 acres in Montgomery district, Punjab, is unique, the nearest approach to it being Army Remount Department farms run for fodder production in conjunction with Remount Depots, and military dairy dry stock farms.

The farm is an independent unit of the Indian Army managed by a King's Commissioned Officer of the Military Farms Department assisted by a small cadre of departmental personnel.

The land comprising the estate is the property of the Punjab Government and has been held on lease since the farm's inception in 1914 when the project was started as an oat hay farm for Army requirements. With the gradual increase in mechanization the production of oat hay was dropped but large reserves of grain (wheat) and *bhusa* were, and still are, available in time of need. As the call on fodder reserves gradually became less, the farm increased its purely agricultural activities and now produces the usual Punjab crops, cotton, wheat, *toria* and mash for sale in the open market. In the near future it will considerably widen the scope of its activities.

Owing to the very large increases in the herds of the military dairy farms and the consequent congestion at the farms, it has been decided that nearby military dairy farms should despatch their dry stock to the Military Farm, Okara. Stock will be maintained until due to calve, when they will be returned to their respective farms.

Batai *system*

The estate is managed on the *batai* system, the whole area with the exception of very bad land being on one-half *batai*. The farm controls the cropping programme and supplies the seed in some cases free and in others on payment and takes one half of the resultant crop. With the exception of cotton the crop is divided at the time of harvesting.

The principal food of the Punjab cultivator being wheat, the tenants' share of this crop is seldom available for sale, being required for his own use until the next harvest comes in. *Toria* provides him with ready money for his half share. Cotton, however, being solely a money crop, is sold *in toto* and this the farm undertakes to do on behalf of the tenant whose personal account is credited with one-half share of the outturn of his fields at the average price obtained for the particular variety he has grown.

The chief aim since the inception of the farm has been the production of pure seed, almost the whole of which is taken by the Agricultural Department of the Punjab for distribution to cultivators. To this end the most rigid control is exercised over seed, all of which is supplied by the farm from trustworthy sources.

As a further measure, a highly efficient mechanical seed cleaner has been installed by which all wheat is purified, cleaned and graded before sale, giving the farm a substantial premium over ordinary market produce. The seed itself is rejuvenated periodically with pure strains obtained from the Agricultural Department farm at Lyallpur. The seed cleaner is also used to grade and purify all purchased seed including berseem before sowing. All wheat reserved for seed is dusted with copper carbonate as a preventive against smut and a proportion is solar-energy-treated at Lyallpur before despatch.

Help of scientists

For the production of pure cotton seed constant liaison with the Lyallpur specialists is maintained. Varietal tests for both *desi* and American cottons are put down each year and selected seed areas are systematically

rogued and tannin-tested* under their supervision. For seed production the farm does its own ginning and, not content with that, also puts all seed through the seed heater—a unique device designed to destroy by heat and pressure the larvae of the pink bollworm.†

The whole area of the estate is canal-irrigated and 741 squares each of 25 acres are cultivated. This entails constant and unremitting outdoor inspection to ensure that the comprehensive programme of crop control is being carried out. Close liaison is maintained with the Canal authorities whose advice and assistance in such matters as siting of watercourses, reconstruction of outlets, etc. have been invaluable. As more land has gradually been brought under cultivation, new watercourses giving a more direct flow, new outlets and straighter *khals* (watercourses) have become possible. The heavy loss of water by seepage, friction and breakages has been considerably reduced by a special method of staking and *lepai* (mixture of mud, *bhusa* and water), and in this case soda and a strict control of the fixed irrigation *wari*‡ of each tenant reduces wastage to a minimum.

As with water so with cropping programmes and, general farm policy. All farming operations are strictly controlled and, allowing for deviations due to irregular or non-productive land the cropping programme for each of the 741 squares is identical. For this purpose the rectangle is divided into ten strips each of 2½ acres and rotation of crops is based on the strip unit.

Provision for manure

One of the difficulties with which a farm of this size has to contend is that of manure. No city rubbish is available and artificials are both expensive and limited in value. Full use is made of green manure in the rotation programme and all village manure is composted in a special manure factory attached to each village. Every tenant is allowed two days' use of his own litter per week for fuel. The balance is carted under farm arrangements to the factory where it is composted and, when ready, is issued to tenants for application to the land.

A village of approximately 50 squares should produce two pits of compost per week sufficient for a manuring programme of about 8 loads per acre per crop. This is admittedly not a large allowance but is better than nothing. In addition tenants are encouraged to use the *khurli* (a portable feeding trough) so as to apply cattle droppings and urine directly on to the land. This system is also combined with the 'sheep and goat' method of reclamation and the tenant-*cum*-shepherd who can support himself on a good square while reclaiming a bad one by folding sheep and goats is encouraged.

Many acres of what appeared to be hopelessly *kallar* land have been reclaimed by the 'sheep and goat' method which though slow is effective. Sheep and goats are folded at night on a fixed area and are moved on when their droppings have accumulated sufficiently to be ploughed in. As an encouragement the farm has started a small herd of Hissar Dale sheep, the male produce of which is sold to tenants to improve their own flocks.

Tenants reside in 17 *chak* villages provided by the estate. Much has been done to keep these in good repair and in a sanitary condition particularly by the provision of chimneys, of fly proof ventilators both for roofs and walls, of good wells with clean water and by the systematic removal of litter and waste to the compost pits. The question of housing on so large an estate is a big one but modern *katcha-pakka* houses provided with verandah and compound walls are gradually replacing the old ones.

Modern machinery used

The fullest use, consistent with local conditions, is made of modern machinery. All wheat is sown by McCormick Deering seed drills. The Ceres plough and lever tooth harrow are fully utilized to supplement country implements and their value is appreciated not

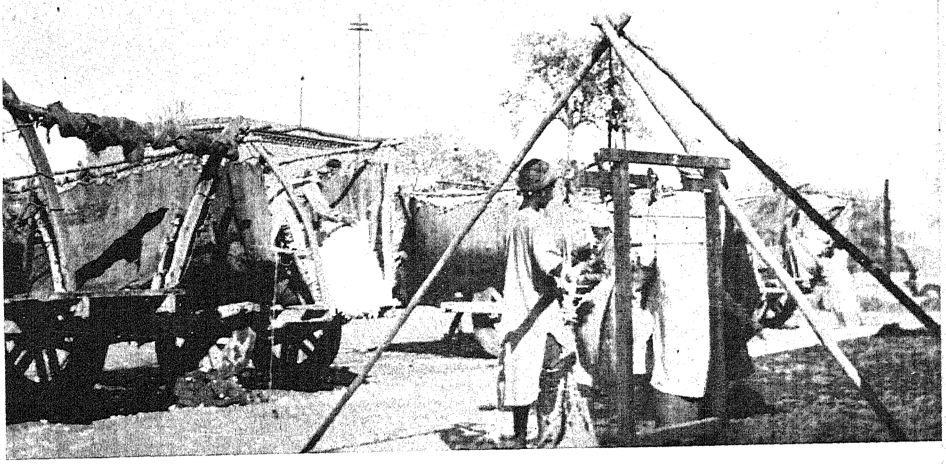
*A test devised by Prof. R. H. Dastur (at present in charge of the research on cotton 'failure' in the Punjab) to find out if plants require additional nitrogen.

† *Indian Journal of Agriculture Science*, Vol. XI, part VI, December 1941, page 906.

‡ *Wari* is a turn. A *wara bandi* is a roster for water, each tenant's name and number of hours of water allowed being entered therein. Time is controlled by ringing a gong in the village office.

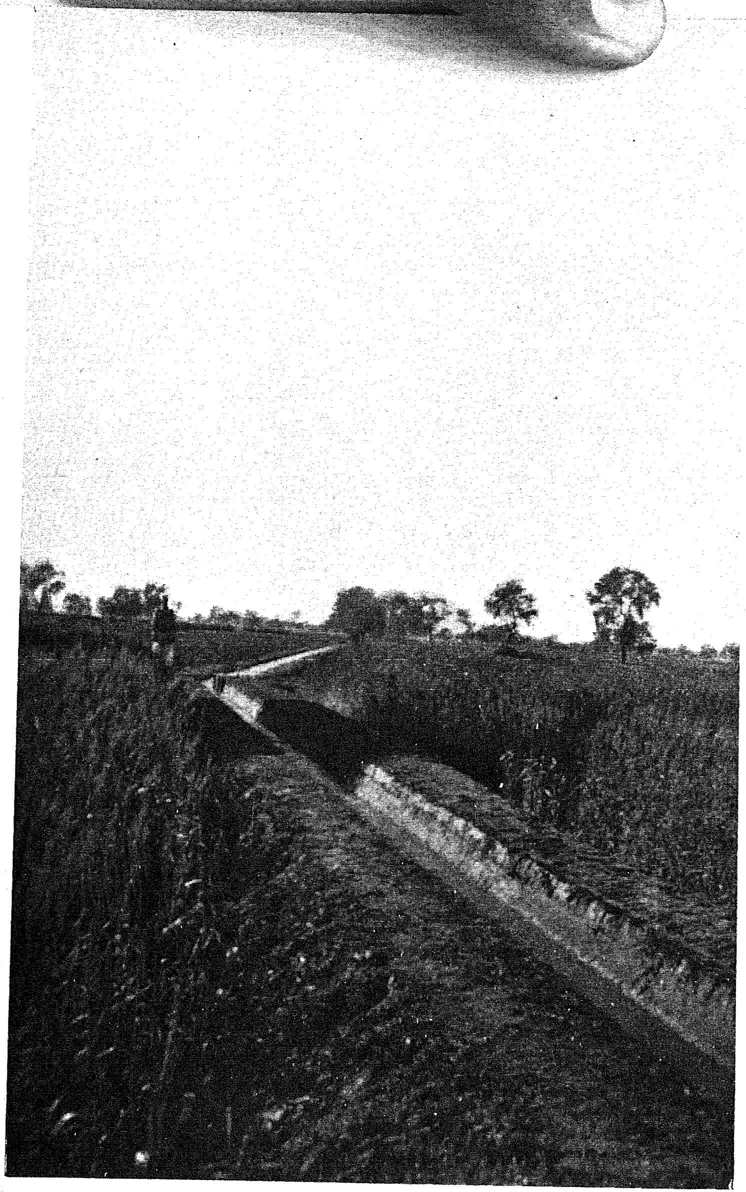
An improved triple Cotto Seed Drill with adjustabl spacing. Set in this pictur to 2 ft. 6 in.

Cotton weighing. The abacus in the foreground shows the number of *pallies* weighed, enabling one weighman to control several weighing points.



A McCormick Deering S Drill for wheat.

PLATE 68



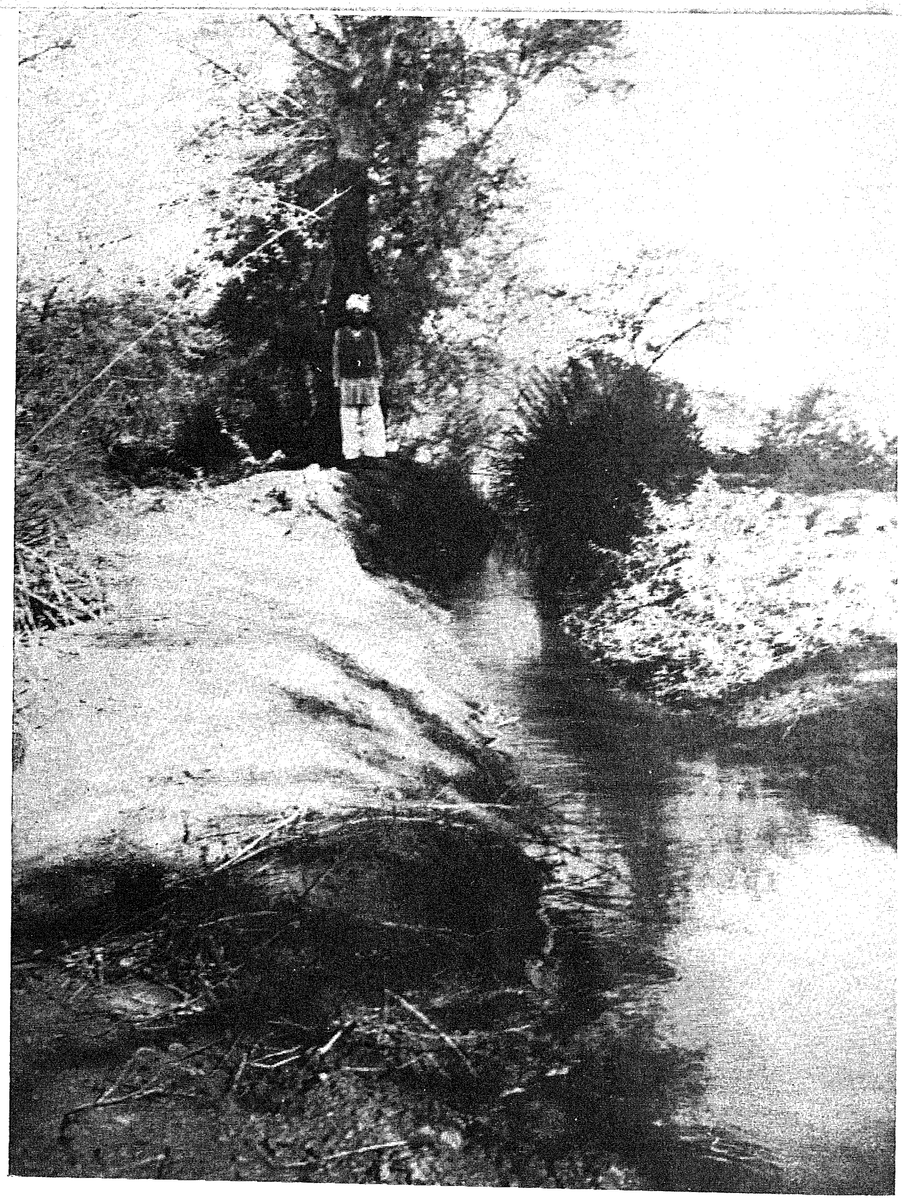


PLATE 69

The Irrigation Department supplies water at the zemindar's door — it is up to him to make the best use of it. A good watercourse minimizing waste and friction (left); (right) a bad one.

only by our own but by outside zemindars who often approach the farm to purchase these implements for them. For sowing cotton an improved *desi* drill sowing three rows at a time with predetermined spacing produces good results.

One useful gadget is the ancient Roman *abacus* adapted for cotton weighing. This consists of a wooden stand supporting three parallel steel wires on each of which are ten steel beads. One bead is spun over for each *palli* weighed and a count of these in all three lines representing units tens and hundreds can be made at a glance at any time to check with the weigh book.

All produce is sold through the local zemindars' co-operative society of which the farm is a member and much of the carting is done by the farm's own pneumatic-tyred carts whose greater capacity and easier load render them well worth the extra initial expense and upkeep. Some comparative loads are given below:

Produce	Country carts	Pneumatic-tyred carts
Bhusa	30 md.	40 md.
Wheat, etc.	14 bags	20 bags
Cotton	25 to 30 md.	30 to 40 md.
Lint	4 *boras*	5 *boras*
Cement	20 cwt.	30 cwt.

Transport for the directing staff consists of two Ford V8 cars, the change-over from horses having been effected several years ago in the interests of both economy and better supervision.

How Village Fund is spent

Something should be said of the use made of the *dharat*. Canal colony law provides for a levy on produce payable by each tenant to the landlord. On the military farm this *dharat* is at present $1\frac{1}{2}$ seers in the maund taken from the common heap, i.e. $\frac{3}{4}$ seer is contributed by each party. Realizations under this head are separately accounted for as a Village Fund and are expended on amenities, both social and personnel, for the tenants.

The principal Village Fund expenditure is on medical facilities, schools and veterinary treatment. The farm maintains a hospital and two outpatient dispensaries staffed by qualified doctors one of whom is a lady for women's and children's work. The medical staff have the use of a V8 station wagon fitted up as a travelling dispensary-*cum*-ambulance and handle an average of 36,000 outpatients and 390 inpatients per year.

Three schools are maintained on the farm, which also lends support to one outside school on its borders.

A veterinary assistant surgeon is employed for treatment to tenants' cattle, and stud bulls are maintained for the improvement of livestock on the estate. Hand tube-well pumps are provided for schools at central points in distant squares and also in villages where the well water has become too brackish for drinking. The simple needs of the tenant are catered for by the installation of village shopkeepers whose charges are controlled and by the provision and upkeep of religious buildings and teachers in each village. In addition provision is made for a yearly *mela* at which prizes for sports, bullocks, ploughing, etc. are awarded.

Necessarily the directing staff is fully occupied and, in these days of petrol rationing and with one's nearest neighbour living several miles away, normal social intercourse is difficult. On the whole, however, the life is both healthy and interesting and brings one into close contact with the daily life of the rural population to the mutual benefit of both.

The outside world

Much time is spent in settling disputes both domestic and social. The policy of the farm is to deal with its social and other problems itself and reference is rarely made to outside civil authority. Village lambardars are carefully selected for their tact and powers of control over their respective communities. Field staff are selected from all communities so that there is no preponderance of any one class. Direct access to the Officer Commanding is the right of every individual and the knowledge that any grievance however slight and whether real or fancied will be listened to does much to make for general contentment and to stop any form of *zulum*. Communal troubles are literally non-existent on

the military farm. All villages are of mixed communities who live in harmony together bound by their common interest in the land.

Large numbers of tenants have been on the farm since 1914. Many have purchased land of their own but still either stay here themselves or keep their sons here in the squares they themselves originally brought under cultivation. During the reallotment of land just completed only 100 tenants left the farm out of a total of 1,100 and for this land over 200 applications were received. The war has not been forgotton. Well over 100 tenants' sons have joined the Forces, and the farm deposits approximately Rs. 500 per month in Defence Savings. The sudden appearance of a smart soldier in khaki in the Office is now fairly common and it is often difficult to recognize in him the country bumpkin who only a few months ago left his plough to fight for his King and country. We look forward to his return, his mission accomplished, when peace reigns again. His training, discipline and knowledge of the outside world will make easier the task of creating a new India.

CONTROL OF RUST-EPIDEMICS OF WHEAT AND BARLEY

By K. C. MEHTA, M.Sc., Ph.D., Sc. D. (CANTAB), F.N.I.
Professor of Botany, Agra College, Agra

THIS article gives only a summarized account of results of general interest obtained from a long-term investigation of the cereal-rust problem of India, started by the writer in 1923 and continued since 1930 under the auspices of the Imperial Council of Agricultural Research. With an acreage of nearly 35 millions, India is one of the prominent wheat-growing countries of the world and at present the largest producer of that commodity in the British Empire. In the greater part of the area under wheat cultivation, all the three rusts, i.e. yellow, brown and black, are fairly common. On account of warm weather, yellow rust is unable to thrive in the plains of Peninsular India and the brown is rather rare; but in the Nilgiris and Palni hills all of them are found in plenty because of congenial climate. The yellow and black rusts of wheat also attack barley which covers nearly 8 million acres.

Colossal damage

As elsewhere, rusts cause colossal damage to wheat and barley crops and the object of this article is to stress the need of a fuller understanding of fundamental facts concerning the factors of their annual recurrence in this country so that steps be taken, without further delay, to mitigate the loss and obtain thereby a better yield from the same area. Rusts are responsible, on an average, for a loss of nearly 60 million rupees (6 crores) annually in the yield from wheat and barley crops taken together.

Each of the three rusts is caused by microscopic germs (uredospores) of a parasitic fungus and spreads from plant to plant with the help of the wind. Under favourable conditions of weather (rain or heavy dews and temperature ranging between 55 to 75°F) each germ may give rise, within 7 to 10 days from the time it alights on a wheat or barley plant, to several blisters (pustules) containing hundreds of fresh germs. That explains how, from a handful of plants each bearing a few blisters in a big field, a serious epidemic may result within 4 to 6 weeks, if conditions of weather happen to be favourable for the development of rust.

Sources of annual recurrence

In the plains of India, initial outbreaks of rusts are delayed by 2 to 3, sometimes 3 to 4 months from the time of sowing wheat and barley. This shows that there is no local source of infection in the soil or on any other plant or plants growing at the time in the plains. Nor could there be any infection within or outside the seed sown, otherwise as stated above, rusts should break out on the new crops in 7 to 10 days from the time the latter emerge from the soil. Experiments carried out by the writer at Agra, which is one of the warmer places, with fresh material of rusts brought down from the hills have conclusively proved that weather conditions in the plains during October-November (the period of wheat and barley sowings) are perfectly suitable for the development of black and brown rusts, whereas the yellow thrives only from the end of November onwards. Notwithstanding this, normally none of the three rusts breaks out at Agra before February. It is clear, therefore, that rusts are reintroduced into the plains, year after year, from some other source. Recent studies have clearly shown that the alternate hosts of black and brown rusts play little part in their initial outbreaks, at any rate, as far as the plains are concerned. In this country, the alternate hosts are restricted to the hills and in the case of yellow rust no alternate host has so far been discovered anywhere. That raises the fundamental question as to where lies the source of rusts for wheat and

barley in the plains. The answer is briefly given below.

(i) Whereas germs of all the three rusts are killed in the plains during the intensely hot summer that follows the harvest, they have repeatedly been found to oversummer on self-sown plants and ratoon tillers of wheat in the hills because of milder weather. At Simla (nearly 7,000 ft. above sea-level) all these rusts have been observed to survive during summer as well as winter in miniature plots during the last 10 years.

(ii) Several times fresh outbreaks of rusts have been noticed in the hills during November-December, i.e. after 4 to 6 weeks of sowing of the new crop, within a few feet of stray plants of wheat covered with the same rust and there is plenty of infective material at altitudes suitable to each rust at the time of new sowings.

(iii) Well-advanced infection of *early* crops in some of the hills has also been found long before rust outbreaks in the neighbouring plains. In general, rusts have been observed to appear much earlier and plant for plant there is heavier infection at foothills than at places farther off in the plains.

(iv) Wheat sown ' out of season ' at some of the foothill stations, at the writer's request, got infected as early as September-October, 2 to 4 weeks before the normal period of sowings in the neighbouring plains.

(v) At a large number of stations in the plains germs of each of the three rusts have been caught from the air on stationary slides well before its appearance on the local crop. At Agra, rust germs have also been caught on kite and balloon-slides long before the initial outbreaks of rusts, from year to year.

(vi) The physiologic-race flora (different strains of each rust) of the hills and the plains are strikingly similar and have supplied, another strong proof of the fact that the source of all the three rusts lies in the hills. Yellow rust, being unable to oversummer normally below 6,000 ft., seems to be blown down originally from higher altitudes. The black and brown are disseminated, in all probability, from comparatively low altitudes.

(vii) Two important foci where, due to *early* crops there is plenty of rust year after year at the time of sowings in the plains, have been located. These are central Nepal in the north and the Nilgiris and Palni hills, taken together, in the south. In addition, hills with altitudes of 6,000 ft. and above are potential foci of all the three rusts. Black and brown rusts may also be disseminated, at least occasionally, from altitudes of nearly 4,000 ft. and above.

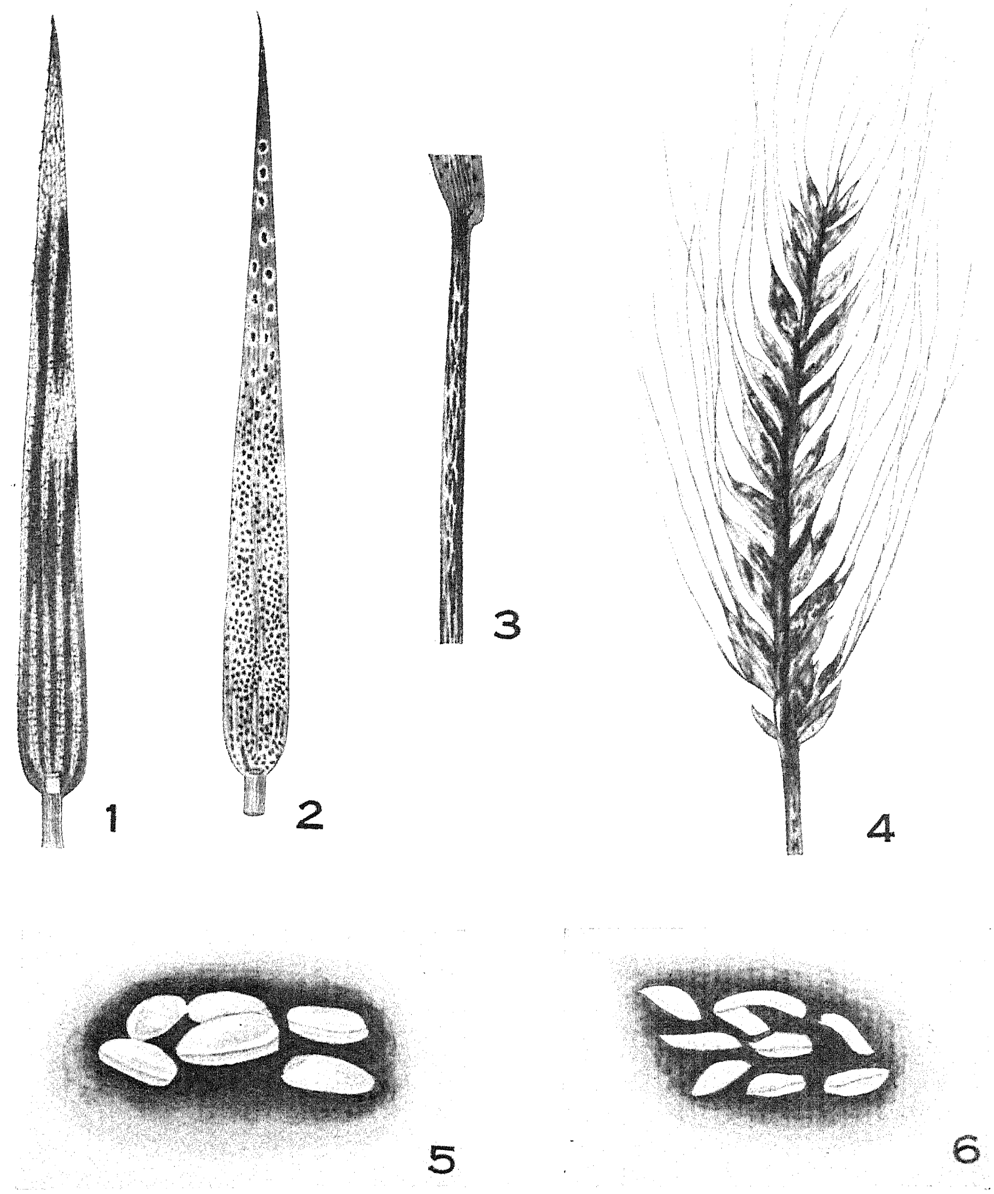
It is important to note that whereas in the hills on account of snow and intensely cold weather during winter, the period of incubation (interval between the time of infection of wheat or barley and the formation of blisters) may vary from 3 to 4 weeks, according to altitude, it is not likely to exceed a fortnight and usually extends to 10 to 12 days only in the plains.

There is nothing to suggest that at any locality in the plains every field, much less each plant, should get infection *direct* from the hills. In fact, this is extremely unlikely and not at all necessary, because after the initial infection of a few odd plants in any field rust should spread from plant to plant much faster in the plains due to milder weather. Later on, infection may spread from one locality in the plains to another as a result of dissemination of germs by the upper-air currents.

Control of epidemics

(i) In so far as the hills cover less than 5 per cent of the total area under wheat and barley in this country, suspension of cultivation of these crops for a period of 2 to 3 years in the hills should be the best method of control. This method, however, would be ineffective without the cooperation of neighbouring states that own a considerable part of the hilly area.

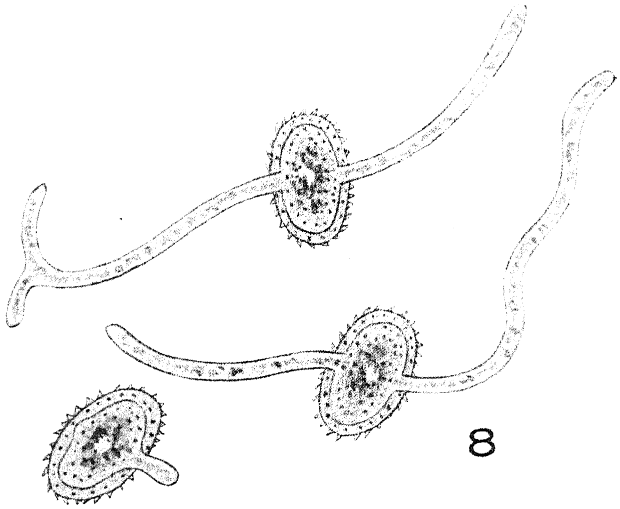
(ii) The other method of control, which is universally recognized, is to grow *only* resistant varieties in the hills wherefrom rusts are reintroduced into the plains, year after year. Unfortunately, there is no variety of wheat or barley showing marked resistance to each of the strains of rusts found in India and therefore work on the breeding of resistant wheats was started by the Imperial Economic Botanist



1. A leaf showing yellow rust.
2. A leaf showing brown rust.
3. Part of a stem showing black rust.
4. An ear showing black rust.
5. Normal wheat grains × $1\frac{1}{2}$.
6. Wheat grains from a badly rusted plant × $1\frac{1}{2}$.

PLATE 70

7



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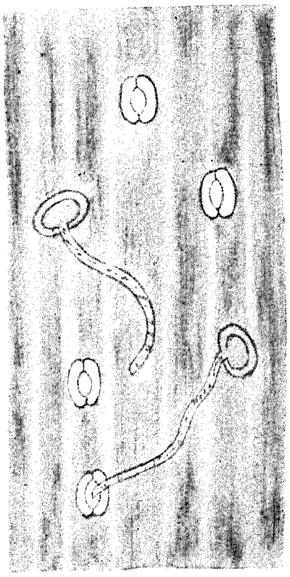

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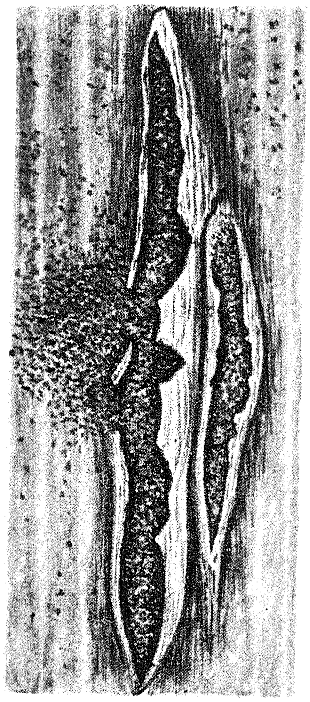

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7. Four germs of black rust (magnified nearly 600 times).
8. Three germs of the above germinating (magnified nearly 600 times).
9. Part of a leaf of wheat showing the entry of a germ by a long tube (diagrammatic).
10. Part of a leaf of wheat with two blisters of black rust, highly magnified and showing scattered germs.

PLATE 71

in collaboration with the writer in 1935. This work is likely to take a few more years.

(iii) ' Clean-up ', i.e. rigorous destruction of ' out of season ' wheat and barley (self-sown plants, ratoon tillers and stubble), which carry over the rusts, 1 to 2 months before sowing in all the hills and hilly tracts should be an effective method of control, in view of very small individual holdings in the hills of this country.

It is essential to point out that ' clean-up ' will have to be enforced even when suitable varieties are available because in the presence of large numbers of rust germs, cloudy weather and considerable moisture even the most resistant varieties have been known to suffer heavily from rust. As stated before, rust germs are available at various altitudes in the hills of India all the year round and conditions of weather described above are also of frequent occurrence in those areas. Consequently, it would be wise to adopt the ' clean-up ' campaign in the hills at an early date and thereby mitigate the loss caused by rusts from year to year at present.

(iv) In view of the small acreage under *early* crops in the Nilgiris, Palni hills and central Nepal, suspension of the first crop (sown during April-June) in the first two areas and postponement of sowings in the last to the normal period, i.e. October, should be the most effective methods of direct control of rust epidemics in the greater part of Peninsular India and the Indo-Gangetic plain, respectively.

In conclusion, it may be stated that the methods recommended under (iii) and (iv) are thoroughly practicable and yet inexpensive. In the earlier stages of their adoption, rusts may appear here and there at the usual time but after subsequent and rigorous enforcement they should not break out *early* enough to cause devastating epidemics over large tracts of the country as at present.

These methods have been approved for trial by competent bodies of the Imperial Council of Agricultural Research as well as by some leading scientists abroad and it now remains with provincial Governments and the states concerned to test their efficacy over a number of years *simultaneously* in their respective territories. For the success of control of rusts by ' clean-up ' it is imperative that zemindars who own land in the hills as well as every cultivator in those areas should cooperate in the campaign.

The writer wishes to express his most grateful thanks to the Imperial Council of Agricultural Research for the grants-in-aid sanctioned for the continuance of investigations on cereal rusts since 1930. Thanks of the writer are also due to members of the rust research staff for their valuable assistance in that work. Other acknowledgments due have been fully recorded in previous contributions by the writer.

BUFFALO BREEDING PAST AND PRESENT

By Syed Iqbal Ali Shah, M.R.C.V.S.
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THE buffalo, of the family *Bovidae*, is a familiar figure in the Indian household. There are three species of this tropical animal, of which *Bubalus arni*, the progenitor of the well known domestic form, is Indian, while two, usually termed the Cape buffaloes, are confined to Africa and have not so far been domesticated. The remains of a few prehistoric species have also been discovered in the gravels of the Narbada Valley and in the Siwalik hills of the Punjab. *Bubalus arni* is indigenous to India and the Indo-Malay archipelago, and is found wild in the swampy *terai* area at the foot of the Himalayas and in parts of Assam, Burma and Central India. The domesticated form of this species is found not only over the whole of India and the greater part of the Straits Settlements but has spread to Asia Minor and North Africa. It was also introduced towards the close of the sixth century into Greece and Italy where it is worked as a beast of burden, particularly in the marshy tracts.

The buffalo is found in the plains and does not inhabit higher altitudes. In its natural state it roams about swampy areas and dense lowland jungles where it thrives on the coarse herbage growing abundantly in these parts.

It loves to wallow in ponds where it gets plastered with mud and mire. This helps to keep it cool and protects it against insect bites. The domestic form has however been introduced to many dry parts of India where this luxury is substituted by a mere wash with a bucketful of water.

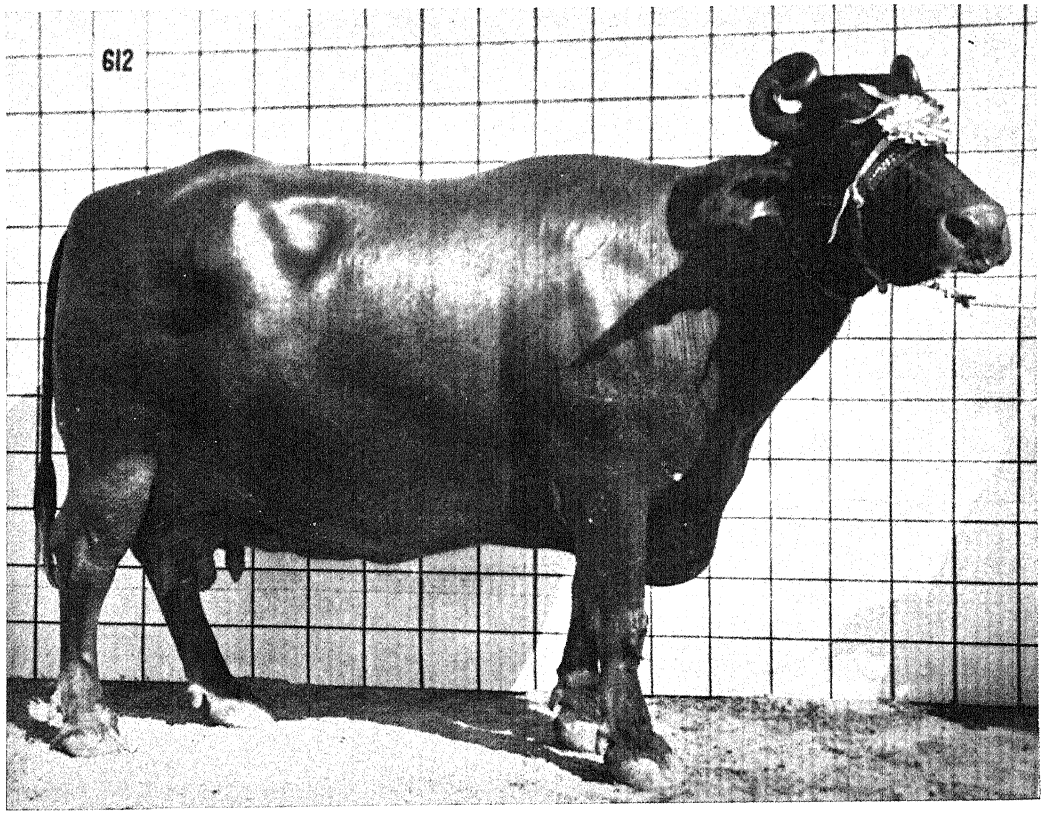
Primarily a dairy animal

The wild buffalo offers exciting and even dangerous sport to the big-game hunter. Buffalo fights and even encounters between buffaloes and tigers were once a festive feature in the courts of the Indian princes. The domestic form is used at places for heavy traction work and in ploughing rice fields, but its reputation as a work animal is very poor because of its sluggishness and inability to withstand the heat of the tropical sun. 'Yoke a buffalo and a bullock together and the buffalo will head towards the pool, the bullock to the upland,' is a country proverb illustrative of this feature. It is primarily a dairy animal and is regarded as a milch animal *par excellence* where milk is used for the preparation of ghee and other indigenous milk products like *khoa* (desiccated milk), curd, etc.

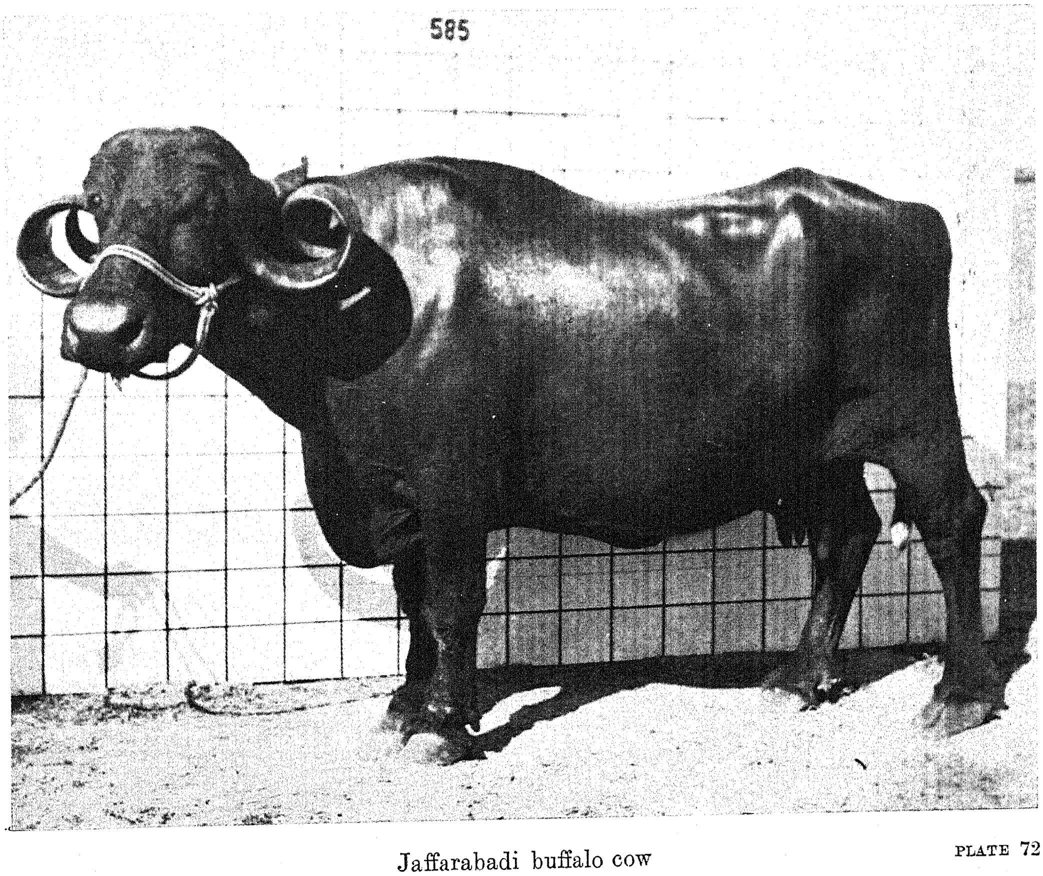
India is the only country in the world where this animal has been specially bred for dairy purposes, and centuries of careful breeding and selection have given to the country a number of excellent breeds. The placid temperament and high degree of docility achieved in this animal illustrate the success of this endeavour. It is strange, however, that these qualities are sometimes misinterpreted for signs of stupidity and dullness. The reverence in which the cow is held by Indians and which is extended even to such a genetically distinct animal like the *nilgai* simply because of its resemblance in name, is however denied to the closely related buffalo.

Lack of sentiment an advantage

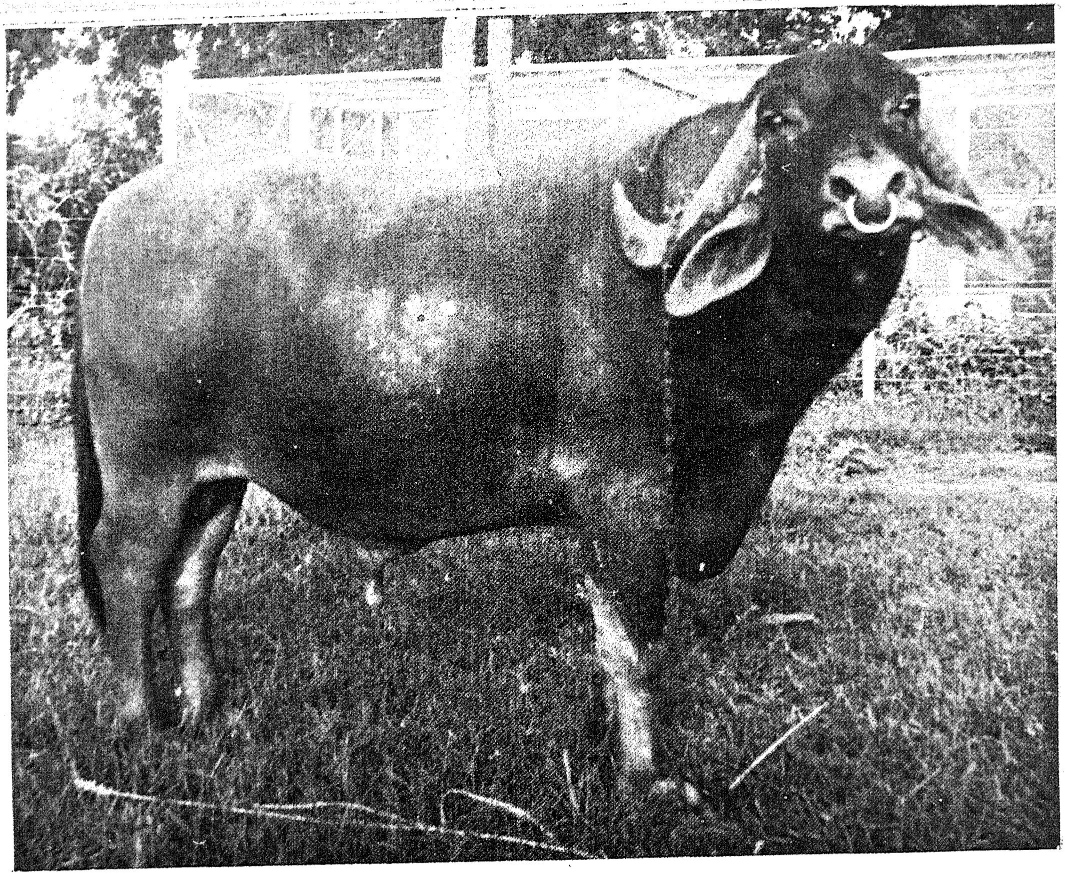
This is very likely due to the colour complex of the average Indian who is usually averse to dark dingy colours. It is not infrequent to find people describing it as a dirty, lazy or stupid animal while some even go to the extreme of asserting that these undesirable attributes are transmitted to the consumer of its milk. In spite of these delusions the animal is accepted as a valuable animal, gentle as a cow, and with a more pronounced dairy temperament. This is clearly reflected in the vast increase in its popularity and numbers in all parts including those where even the optimum conditions for the breeding of this animal do not exist.



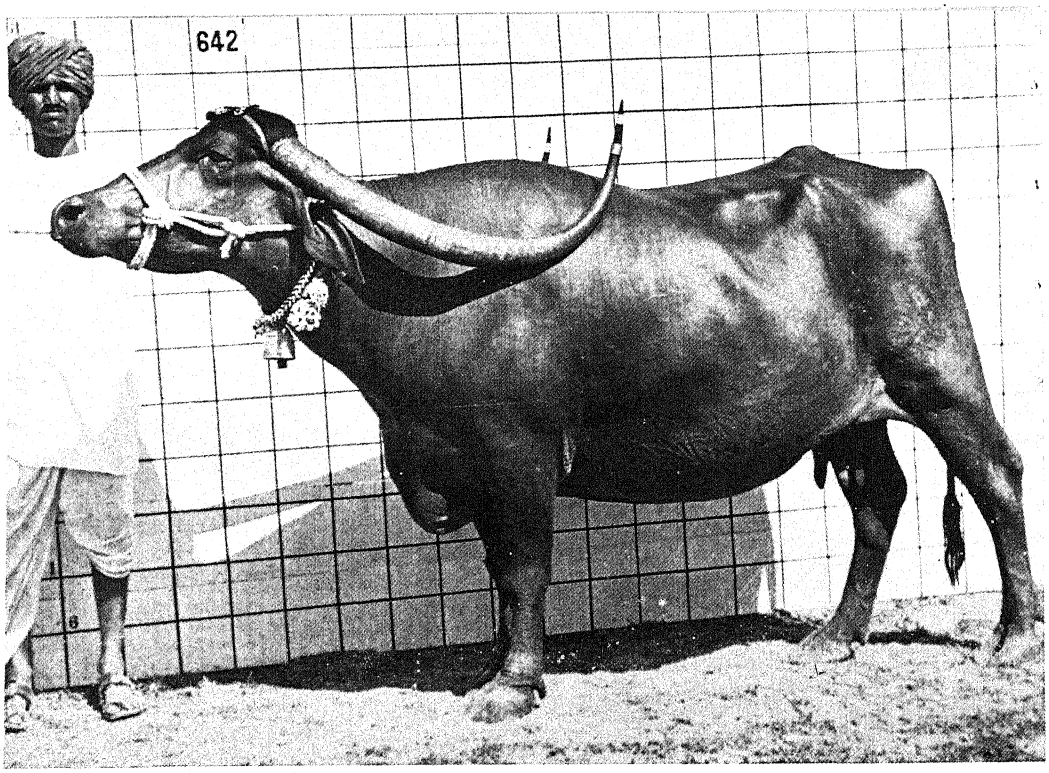
Murrah buffalo cow



Jaffarabadi buffalo cow



Surti buffalo bull



Nagpuri buffalo cow

Absence of religious sentiment helps a great deal in the culling of worthless stock, thus ensuring a greater purity of type. In actual practice the buffalo has almost replaced the cow as a dairy animal. The Royal Commission on Agriculture observes : ' The she-buffalo rather than the cow is the milk producing animal of India. Her milk is richer, containing as it does from 2 to 3 per cent more butterfat than that of the ordinary cow, and wherever there is a good market for milk and its products it is the buffalo that is kept to supply it. ' The report of the Expert Scientific Adviser for dairying has the following explanatory passage : ' It is indeed not difficult to explain the popularity of the she-buffalo. Her average milk yield is markedly higher than that of the ordinary village cow, the butterfat content of her milk is also higher than that of cow's milk while she appears to possess a remarkable ability to convert coarse fodders into milk. A detailed statistical study by the Imperial Council of Agricultural Research in the comparative efficiency of different types of livestock maintained at the Military dairy farms reveals that when prices of fodder are low, the she-buffalo (purchased or ordinary village-bred one) can compete with any breed of Indian cows (including the cross-bred, and the specially bred Indian cow) in butter production and beats the ordinary Indian cow in the production of both milk and butterfat, and that under existing conditions the buffalo is more economical for the villager than the cow, as the free grazing she gets on the roadside enables her to beat the cow in the production of both milk and butter.'

Doubts and difficulties

The Imperial Dairy Expert adds that ' a buffalo is easier to fatten and fetches better butchers' value than the cow, as it yields a larger carcase, contains more fat, and gives a better hide '. However, all these advantages were for a long while unable to earn recognition for the animal, primarily because the dairying industry in the country is not fully organized, and animal husbandry activities have been concentrated on the pressing problems of the improvement of the breeds of cattle which supply the motive power for the agricultural operations of the country. It has also been questioned whether it is at all profitable to breed an animal like the buffalo solely for milk production when the cultivator—and India is a land of cultivators—will have to maintain cows in addition for getting bullocks. It has been maintained that if the milk-yield of the cow could be raised by selection for high yielding strains, better feeding and management they would provide both milk and the working bullocks. This policy of breeding cattle on dual purpose lines was one of the principal reasons for pushing the breeding of buffaloes into the background. It has, however, been amply demonstrated that there are fundamental reasons against the continuation of this policy. It is regarded as a genetical impossibility to breed both draught qualities and milk into the same animal, and expect any measure of success in either. Thus the grave danger in pursuing such a policy was pointed out by the Royal Commission on Agriculture in the following words : ' In attempting to secure more milk from the fine types of draught cattle still to be found in many parts of India there is a real danger that the qualities which have in the past commended them to the cultivator will be lost. The Commission also observed : ' It is evident that both in the economy of the ordinary village and on the holdings of those engaged in dairying room should be found for both species. There should in our view be no relaxation in the efforts to improve the buffalo. ' That the buffalo does find room in the economy of the rural home is seen from the fact that the number of buffaloes in India has increased by 13 per cent within the past 25 years, and in the Punjab where, with the widespread introduction of canal irrigation, favourable conditions for the breeding of buffaloes have been induced, the number of buffaloes in the province has exceeded that of cows in spite of the province being an intensively cultivated tract and the proud possessor of the finest breeds of draught and dairy cattle in India.

Another striking illustration of this contention is provided by facts ascertained during the recent cattle and milk enquiry conducted by the Imperial Council of Agricultural Research in seven breeding tracts of India. In

the district of Montgomery (Punjab), the home of the famous Sahiwal cow, admittedly the best milch animal in India, it was ascertained that the proportion of buffaloes to cows per holding was 2·1 to 1·0 and that their average daily milk yield was 8·42 lb. and 4·72 lb. respectively. From the fact that the buffalo gives almost double the quantity of milk given by the cow, and that the proportion of buffaloes to cows is more than two to one, it is evident that more than three-fourths of the total milk produced in the district is derived from the buffalo. Thus, if the buffalo can successfully compete with quality cattle like the Sahiwal, there is reason to believe that, given an adequate amount of attention and encouragement, this animal can be a really valuable asset to the country. The average buffalo of India is greatly superior to the average cow in the country and is much better looked after. There is a greater purity of type and a well-marked freedom from disease, deformity and unthriftiness. There is certainly vast scope for further improvement.

Basic types and breeds

Two main types of the Indian buffalo have been described. The type *macrocerus* has very long horns nearly straight and well thrown back. In the British Museum is a detached horn of this variety which measures 6 ft. 6 in., indicating a span of about 14 ft. from tip to tip in the pair. The other type, *spirocerus*, has much shorter but well-curved horns. The best buffaloes belong to this type and certain strains such as the Nili buffaloes of the Punjab have extremely close-curled horns. The closeness of the curl is regarded in these parts both as a good point and an index of the quailty of the animal. A Punjabi couplet, the English translation of which is given below, aptly describes the value placed on this feature :

Everyone talks of buffaloes.
Those are in fact fairies
That possess tightly curled horns,
Give vessels full of milk.

Local prejudices and preferences have evolved a score of so-called breeds in all parts of the country : but there are four well-marked basic breeds.

The Murrah is perhaps the best milch buffalo and constitutes about 20 per cent of the entire buboline strength of the country. The breeding area extends over a long range in the Punjab, the United Provinces and Sind. They are distinguished by the close-curled horns, light head and neck, deep massive bodies and short, stocky limbs. Good specimens yield between six and nine thousand pounds of milk in a lactation. It was a Murrah buffalo which stood first in the milking competition organized at the third All-India Cattle Show at New Delhi, and it was again a Murrah buffalo that was declared the best animal exhibited at that show.

The Jaffarabadi is another heavy type buffalo, loosely knit and long-barrelled. The very prominent forehead, heavy broad horns that sometimes cover the eyes and droop on the side of the neck, curling up in an incomplete coil are characteristic. The purest type is found in the Gir forest of Kathiawar. Good specimens give an average of four to six thousand pounds of milk in a lactation. The breed is famous for the remarkably high butter fat content of its milk.

Surti buffaloes are a lighter and smaller type. They are bred in the central part of the Bombay province. These and the Mehsana buffaloes, which are a cross between Surti and Murrah, are considered very valuable milch animals on account of their early maturity, regularity in breeding and good milk-yield. The average yield of a good specimen ranges between four to six thousand pounds in a lactation.

Nagpuri buffaloes of central and southern India are a long-horned variety and are characterized by their light build, long flat and curved horns carried almost straight back and long light limbs. The milk-yield of good specimens averages between three to five thousand pounds in a lactation.

Breeding work in progress

There are few Government-owned herds of any importance devoted to the raising of quality buffaloes, study of problems peculiar to the animal or distribution of pedigree bulls. A few buffaloes are kept here and there at agricultural stations, experimental and teaching

institutions, etc. A good number are being maintained at the various military dairy farms, but they are usually purchased animals.

The Civil Veterinary Department of the Punjab has devoted a good deal of attention to the buffalo, and a brief resume of its activities might interest the reader.

Definition of breed characteristics

The first prerequisite in any scheme of the development of an animal is to obtain a precise definition of the breed characteristics to be able to formulate an ideal breeding policy. There are three distinct breeds of buffaloes in the Punjab and the Imperial Council of Agricultural Research has provided grants for obtaining the definition of their characteristics. The Murrah breed characteristics have been described by Capt. U. W. F. Walker, Director of Veterinary Services, while the writer is arranging for the description of the Nili and Ravi breeds.

The production of high-class stock is an expensive and specialized undertaking and can only be successfully achieved if the main object lies in scientific breeding. This work cannot be carried out in villages. A representative conference of experts and others interested in the subject convened by His Excellency the Governor of the Punjab in November 1936 considered this a vital question and resolved that 'when provincial finances allow a Government breeding farm should be started'. In the meantime the grantee farm for breeding Hissar cattle at Bahadurnagar has been converted into a buffalo breeding farm, to breed the well-known Nili and Ravi buffaloes of the Punjab. The Punjab Government leased this farm on buffalo breeding conditions for 20 years with effect from 11 January 1936. Situated in the Montgomery district, the farm comprised an area of 3,049 acres of canal-irrigated land and is ideally suited for buffalo breeding. According to the conditions of the lease the lessee is required to keep a fixed acreage under fodder and pasturage and maintain a herd of 300 buffaloes and six bulls approved by the Department. The total stock in the herd on 31 March 1940 was 515. The farm is the first of its kind, with the largest buffalo breeding herd in India. Excellent byres, milking sheds, milk reception room, utensil cleaning room, etc. are provided with arrangements for drinking water from wells. An experienced gazetted officer of the Civil Veterinary Department guides and controls the breeding work of this herd in addition to five cattle-breeding grantee farms under the direct supervision of the Director of Veterinary Services. A Veterinary Assistant Surgeon visits the farm weekly to maintain accurate milk records and carry out other work.

He is also responsible for the health of the stock and arranges for prophylactic vaccination and control of diseases, contagious and otherwise. Calves are weaned at birth and accurate breeding and performance records are maintained. This farm will not only be the pioneer buffalo improvement centre in India, providing much-needed material for research but will be for a long time to come the chief source of pedigree bulls in the province.

Increase in high-class buffalo bulls

'The bull is half the herd,' is an oft-quoted fundamental truth. Its quality and type decide the future of a herd, and generally more care is exercised in the choice of a buffalo bull. The supply of good bulls is at present restricted to the villages in the breeding tracts of the Murrah, Nili and Ravi breeds while the Bahadurnagar Farm will shortly contribute its share also. Out of the funds provided the Department purchases good bulls and issues them out to the villages. There were 598 bulls working in the province on 31 March 1940. This number is augmented by the approval and registration of good privately owned bulls. There was a total of 7,436 approved buffalo bulls at stud in the province on 31 March 1940.

Registration of stock

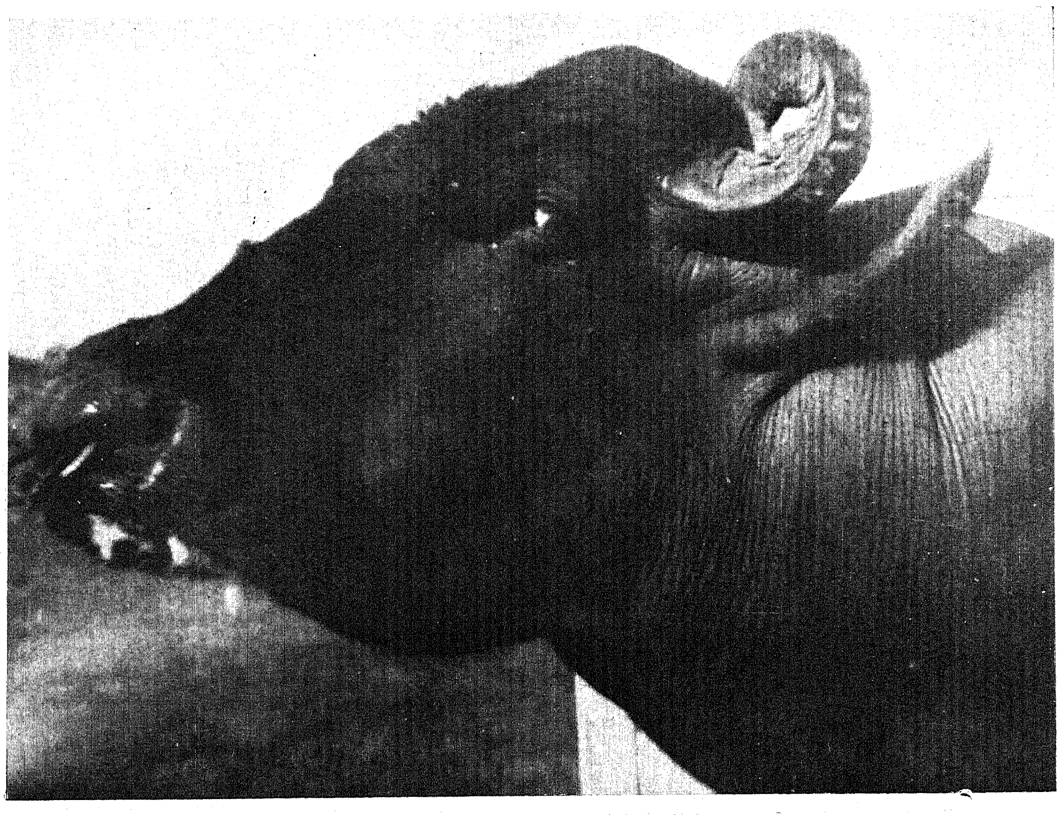
Registration of stock aims at separating animals which the breeders wish to breed, ensuring the maintenance and development of strains conforming to the ideal type and the requisite production level. With this consideration in view it has been recommended that 'a system of herd books should be started in regard to buffaloes in suitable

areas for the Murrah and Nili types'. This scheme has not yet materialized, but a beginning has been made for the Murrah breed by the starting of a milk recording scheme with a grant-in-aid from the Imperial Council of Agricultural Research. Milk records are an essential preliminary to the starting of a herd book for a milch breed, for the correct criterion to decide the suitability of an animal for inclusion in the herd is not only its type but also its performance at the milk pail. A milk recorder has been appointed with effect from May 1939 with headquarters at Rohtak. He has organized three milk-recording societies with 116 members who have 116 buffaloes.

It has been the experience of the Civil Veterinary Department that organization of breeders in groups is an excellent means for arousing interest in better stock. A large number of buffalo breeding societies have been started, some of which ultimately are registered with the Cooperative Department. These societies have as their nucleus an approved buffalo bull, the members undertaking to get their buffaloes served by this bull and maintain breeding records under the supervision of the *ilaqa* veterinary assistant.

In addition to a few cooperative buffalo breeding societies there are as many as 1,222 societies registered with the Civil Veterinary Department.

The buffalo with head towards the pool, the ox to the upland



Head of a Nili bull—the breed with the closest curled horns in India

A herd of *Thurinji thazai madu* penned in arable land for their valuable manure. The two dark coloured animals are evidently hybrids. Note the difference in size and shape of the horns. The animal with prominent hump in the right foreground is a bull.

A cow and a calf of *Thurinji thazai madu* browsing on the leaves of *Albizzia amara* Boivin

CATTLE AVERSE TO GRASS

By K. CHERIAN JACOB, L.AG., F.L.S.

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IN a few villages adjoining the hilly parts of North Arcot and Salem districts in the Madras Province, a few ryots maintain a breed of cattle which do not ordinarily eat grass but browse the tender shoots and leaves of *Albizzia amara* Boivin. (Tamil: *thurinji, wunja*; Telugu: *nallarenga.*) In November 1940 the writer had occasion to see a herd of this breed of cattle at Kottur, a village near Krishnagiri in the Salem district. The cattle did not seem to take any notice of the rich growth of very good fodder grasses, but were briskly going about to get at the tender shoots and leaves of *Albizzia amara.* The agricultural officers of the place and the villagers informed the writer that these animals do not eat grass but feed only on the leaves of *thurinji.* Fully aware of the peculiar feeding habits of this breed, herds of them are allowed to pass through footpaths in cultivated fields with apparent immunity to growing crops. They easily cover 10 to 12 miles daily in search of their favourite forage in the unreserved forests. It is a hard job for the cowboys to keep pace with them and much more to keep the straying individuals together.

Even the milch cows are not fed with any concentrated food. Probably there is no necessity for this food since they feed on young leaves and shoots which are rich in protein.

Characteristics

The animals are of a wiry build, agile, fleet-footed and of medium size. They have a whitish coat and possess short but pointed horns. The writer was told the story of a herd which chased and gored to death a *cheetah* which lifted a calf from the herd. Since they live usually on the leaves of *thurinji,* this breed of cattle is known as *Thurinji thazhai madu,* i.e. cattle which feed on the leaves of *thurinji.* The cows give one to one and a half local measures of milk each time (4 to 6 lb. a day). The milk of this breed is considered to be sweeter and more nutritious than that of the other local types. It has a slightly greenish tinge probably due to the fact these cows exclusively feed on green *thurinji* leaves.

Apart from the dam's milk, the young calves have to be fed on tender *thurinji* leaves as they too do not eat even the tenderest of grasses. So it is obvious this quality is inherited.

The colour of the fresh dung is green. The dung and urine of the cattle have superior manurial value evidently due to their exclusive leguminous feed and the animals are maintained chiefly for that purpose. Herds are penned for the night in the open fields of arable land much in the same manner as sheep penning. The animals are tied by one of their forelegs to wooden pegs driven into the ground.

This enquiry has been confirmed in the main by the District Forest Officer, Salem North, agricultural officers of various places where this breed is found and important ryots owning the cattle in the various tracts who also furnished some more interesting facts about this breed of cattle. Many herds of this breed are found in a number of villages adjoining hilly tracts such as Koraikuppam near Bargur in the Salem district; Gudiyattam, Pernampet, etc. in the North Arcot district.

Good for work

In some places these cattle are in a semi-wild state and are not put to any farm operations, while in other places they have become very docile and the bulls are used for all sorts of farm operations. They are said to work even better than other cattle when *thurinji* leaves are available in plenty for browsing.

On days they are put to work they are let off for browsing by 2 p.m. and they return to the village by 7 p.m. They eat nothing but *thurinji* leaves, but during summer when these trees become defoliated for a short time or when the animals are prevented from walking long distances due to an attack of foot-and-mouth disease, they are compelled to eat anything they are given such as *cholam* (*Sorghum* sp.) stalks, rice straw and grass. They prefer *cholam* stalk to rice straw or grass. The animals have strangely an aptitude for eating bones. In some places, they are actually fed with small pieces of bone once or twice a month. They are reported to be very prolific breeders.

In some herds a few coloured animals are found owing to the erossing of these animals with other village cattle.

The animals of this breed are comparatively cheap just because they cannot be maintained in places where *thurinji* plants are not available in plenty.

The Forest Department does not allow these cattle to graze in the reserved forests while the other village cattle are allowed to graze by permits. The District Forest Officer desires that this peculiar breed of cattle may not be encouraged to thrive, as they are detrimental to *thurinji*, a very important tree used for fuel in the majority of the dry deciduous forests in this province.

Albizzia amara is a moderate-sized deciduous tree with low and spreading branches. Leaves are very many bipinnately compound with very small leaflets. The young shoots are clothed with yellowish grey pubescence. The heads of flowers are fragrant with pinkish-white florets. Corolla yellow, nearly three times as long as calyx, pubescent outside. Pods 4 to 7 in. by $\frac{3}{4}$ to $1\frac{1}{8}$ in., stalked, thin, flat, abruptly pointed, slightly transversely veined. Seeds 6 to 8. It is found throughout tropical India in dry forests. The basal portion of this tree is irregularly branched. The branches are so low and spreading that the cowboys easily bend them for the leaves to be browsed by the cattle.

PRODUCTION OF FODDER IN A SPROUTING CABINET

By MALIK FAZL HOSAIN, DIP. AGRIC. (WYE.)
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TODAY stock owners in every country realize the importance of a good quality, succulent green feed in the ration of stock for maintaining the animals in health and optimum production. The regular supply of green fodder all the year round, unfortunately, is difficult; for climatic conditions and water supply often prove to be limiting factors in the successful production of fodder.

During recent years, attempts have been made to produce continuously green fodder in artificial surroundings where the germination and sprouting of grain are effected in a specially designed cabinet, with arrangements for plant nutrients to be sprayed in liquid form upon the seed. The temperature and humidity within the cabinet are so controlled as to promote the rapid growth of the green forage.

The germination of grains in a sprouting cabinet has been developed to a considerable extent in Great Britain and other countries, and it is reported that in South Africa the use of such cabinets is extending. The possibilities of this new process in a tropical country such as India will probably depend upon how successfully one can control the widely variable temperatures and humidities prevalent in different parts of the country. Apart from studying the scientific aspect of the process, the economic question also demands most careful consideration.

Vita-plant process

During the last three years, the Vita-plant process of sprouting grain has been tried out in the Imperial Veterinary Research Institute in a specially designed sprouting cabinet, supplied by the Port Engineering Works of Calcutta. The structural design of the cabinet may briefly be described as follows:

The cabinet is built of strongly rivetted galvanized iron and is divided into several sections. Each section contains a number of trays for holding the germinating grain and the sprouts. A tank is provided at the top of the cabinet and is connected with feed pipes, terminating in spray taps, which automatically supply the nutrient solution to the interior of the cabinet for the purposes of soaking and feeding the grains. A heating arrangement is also provided by which the requisite temperature inside the cabinet is maintained. There are several different sizes of cabinet available in the market. The cabinet used in the present instance measures 5 ft. 9 in.×5 ft. 0 in. ×6 ft. 5 in. and is provided with 48 trays.

Simple operation

The operation of the 'cabinet culture system' is simple and does not require any skilled knowledge for its manipulation. The various steps of the operation may be described as follows:

1. The requisite quantities of seed (5 lb. per tray) are screened, washed well to remove extraneous matter and then allowed to soak in water. The damaged and broken seeds which float up are rejected.
2. The selected grains are then spread on the trays, which must previously have been thoroughly cleaned with an antiseptic solution.
3. The overhead tank is filled with water and charged with a solution of nutrient salts.
4. For three minutes each day, the nutrient solution is rained from the tank into the trays below.
5. In order to prevent mould growth, 1 oz. of anti-mould solution (40 per cent formaline in water) is added to the nutrient solution in the tank once a week.
6. Before starting the cabinet working, the oil lamps are lighted to produce the required temperature and the doors of the cabinet are closed.

The first test with the cabinet was carried

out during the summer months of 1938. The seed selected for germination was maize. It was found that, though the results of the sprouting were quite promising, the summer temperature conditions of Izatnagar and the fluctuating humidity (from very dry in early May to very moist in late August) were not ideal for working the cabinet. The cabinet is designed to run at 75°F, but the outside temperature was so high that the cabinet had to be run without operating the heating system. Moreover, it was found that the sprouts were easily attacked by mould and that these mouldy sprouts were not relished by the cattle.

Winter trials

The second test was carried out in the winter months of 1938-1939, when the average minimum and maximum temperature in the open were 45°F and 70°F respectively. Occasionally the noon temperature rose to 80°F, when the heating system had to be closed for a short time to allow the cabinet to run at the standard temperature. There were also one or two cold nights, when the temperature inside the cabinet, in spite of the lamps burning, went down to below 65°F. In this trial, maize, wheat, oats, barley, *Reana luxurians* and sorghum were tried. The last two did not do well; hence the quantity of sprouts produced is not reported, but promising results were obtained from maize, wheat, oats and barley. Five pounds of maize seed was found to provide 25 lb. of green fodder on the 12th day. It was also shown that, when the trays containing green fodder were kept up to the 18th day, the plants began to droop and mould started to appear. In some cases, the growth of mould was noticed on broken grains on the fourth and fifth day. This mould growth, however, was checked by adding anti-mould solution to the nutrient reservoir. On the 12th day, the sprouting grains were fed to the farm working bullocks and were found to be highly relished. A marked improvement was also noticed in the general health of those cattle which were fed on the sprouted grains.

The third test was carried out in September, 1940. The average outside temperature recorded at the time was 94°F. For sprouting 120 lb. of oats and 120 lb. of maize were used. As the outside temperature was high, no artificial heating of the cabinet was found necessary. On the contrary, in order to maintain the temperature at the correct working level, the doors of the room housing the cabinet had to be covered with thatched shutters. On this occasion, all seeds were found to germinate after 36 hours. When the plants reached a height of three inches, mould started to appear. This could not be kept down even by using the anti-mould solution. This observation thus confirms the one made in the summer months of the previous year, that is, that even though the grains germinate and the sprouts grow successfully, the incursion of mould adversely affects the forage in the cabinet during the summer months. With the growth of mould, a strong, offensive odour was apparent in the forage and this led to the animals refusing the sprouted feed whenever it was offered.

The fourth test was carried out in November, 1940, when the maximum outside temperature ranged from 75° to 85°F. In this test two kinds of seeds, namely maize and barley, were tried out in a series of four independent experiments. In each trial, every attempt was made to grow the sprouts at the ideal condition of temperature prescribed, that is at 75±2°F, and detailed observations were recorded concerning

(*a*) attack by mould,
(*b*) the yield of forage,
(*c*) the quality of forage produced, as revealed from chemical analysis, and
(*d*) the cost of production of the forage.

Attack by mould

The general observations recorded in these trials tend to show that the forage produced in the cabinet is attacked by mould on the fourth day of growth, but is easily suppressed on the application of anti-mould solution and that this check on mould growth remains effective up to the eighth day. On the ninth day, again a mild growth of mould starts. This, however, can be quickly checked by the reapplication of the anti-mould solution. The

yield of forage on the four occasions recorded was as follows :

Trial	Seed	Quantity of seed lb.	Age of forage	Yield lb.
1	Maize .	5	12 days .	40
	Barley .	5	12 days .	40
2	Maize .	5	10 days .	38
	Barley .	5	10 days .	33
3	Maize .	5	10 days .	35
	Barley .	5	10 days .	30
4	Maize .	5	8 days .	34
	Barley .	5	8 days .	30

Cost of production

As on the eighth day the green fodders reach the required growth of six inches, and because there is no marked difference between the yield on the eighth, tenth or twelfth day, the overhead cost may be computed on a seven-day basis and shown under the following heads :*

	Rs.	A.	P.
Depreciation†	2	13	0
Cost of fuel	2	0	0
Labour	1	0	0
Cost of seed	10	0	0
Nutrient and anti-mould solution .	2	9	0
	18	6	0

Fodder produced—

Maize	1,632 lb.
Barley	1,440 lb.

On this basis, the cost of production can be said to be roughly 14 as. per maund.

Discussion of results

The results of the experiments tend to show that, under Izatnagar conditions (which may be considered as typical of those in the greater part of northern India), the possibilities of growing fodder in this type of cabinet are circumscribed by a long spell of summer weather (over six months). During these summer months, the outside temperature is so high that it is difficult to maintain the cabinet at 75°F, which is the optimum temperature for the successful growth of the forage. Moreover, during this period, the range of variation of humidity is very large. It starts from a low level at the beginning of the summer and rapidly increases with the progress of summer and the advent of the monsoon. The high humidity was found to lead to the growth of mould which cannot always be effectively suppressed by anti-mould solution. The mouldy forage is not only unpalatable but may also have a deleterious effect upon the health of the animals.

In the winter months, it appears that fodder can be successfully grown in the cabinet under certain controlled conditions. The product obtained from the cabinet is palatable and quite fresh. Nevertheless, it is questionable whether the cost of production justifies the adoption of this method of growing fodder. The chemical analysis of the different sprouts under the present test has been made and when one refers to the chemical analysis and attempts to evaluate the economics of the process, the following facts require consideration.

The dry matter content of the sprouted maize grain at the end of a week is 6·7 per cent. Therefore, the total dry matter obtainable from 34 lb. of sprouted grain is about 2·3 lb. Taking the dry matter content in maize seed to be 90 per cent, then 2·3 lb. of dry matter in the sproutings has been obtained from 4·5 lb. of dry maize seeds. Thus, during the cabinet culture, about 50 per cent of the dry matter in the original seed is lost.

The protein in dry maize seed is about 9·37 per cent; the protein in dry maize sproutings has been found to be 23·94 per cent. Thus, during one week of cabinet growth, the total protein in maize grains increases from 0·42 lb. to 0·55 lb. (about 30 per cent increase).

On the same basis of calculation, it is evident that, during the sprouting of the barley seed, about 40 per cent of the dry matter is lost but the protein content of the sprouted grain increases from 0·36 lb. to 0·54 lb. (50 per cent).

If the protein content, which is the most important item of the feed, is taken as the sole index for fixing the price, the price of maize sproutings should be Rs. 13, when the price of the seed producing that quantity of sprouts

* Computation is made on a seven-day basis (*a*) because by that time yield is maximal, (*b*) mould growth is especially liable to be dominant after that time.

† At 10 per cent per annum on the capital outlay.

is Rs. 10. On the same basis, the price of barley sproutings should be Rs. 15 when the seed producing the sprouts costs Rs. 10. But the overhead cost for producing the sproutings from both the seeds comes to about Rs. 18-6, so that the net effect in undertaking cabinet culture is an economic loss per week of about Rs. 5-6 for maize and Rs. 3-6 for barley. During the process of cabinet culture of grains, a small quantity of carotene is produced in the sproutings. This, however, cannot compensate for the extra expenditure. Furthermore, one cannot overlook the large losses (50 per cent in maize and 40 per cent in barley) in the total dry matter (which represents valuable energy-giving carbohydrates) during the process of sprouting.

Conclusion

Recently in a book entitled *The Principles and Practice of Feeding Farm Animals*, E. T. Halnan and F. H. Garner of Cambridge commenting upon the results of the experiments on the cabinet method of sprouting grain carried out during the last few years in Great Britain, observed that 'it is difficult to conceive that this process can increase the nutrients available, for one knows, that when seeds germinate, a certain amount of plant food is burnt up from the grain. Actual experimental evidence shows that this is the case and actually there may be a loss of 25 per cent of the dry matter of the grain. Whether the loss is worth while in converting the grain into a succulent food is a question that only individuals can decide for themselves. The resulting product may be useful in dry districts or in places where succulent foods are difficult to grow, or cannot be grown; for ordinary farmers in this country it is a moot point as to whether it is worth while'. In fact, the authors have concluded that 'with the present knowledge, sprouting of grain for stock feeding is not worth while for ordinary farm stock'.

The conclusions arrived at from the results of the present series of investigations substantially reinforce the views expressed by Halnan and Garner. Although it is admitted that the failure in the proper feeding of livestock in India is mainly due to the absence of a green feed in the ration during the greater part of a year, it may reasonably be contended that the cabinet process of producing fodder cannot, for several reasons, meet the problem of an adequate fodder supply.

In fact, the Vita-plant process of sprouting grains in a cabinet for producing fodder may be considered to be not only of questionable economic value but also too difficult to be recommended to ordinary Indian cultivators. It is, indeed, difficult to conceive how the process could even be recommended for use in organized dairies or in Government veterinary hospitals or in other comparatively well-to-do institutions.

Acknowledgements

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HONEY AND ITS USES

By

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HONEY has been a very valued article with Indians from time immemorial. It was used as a sweetening agent and as medicine. It still retains its hold over the Indian mind as medicine, but as a sweetening agent it has lost its charm. This may be due partly to the fact that there is not enough honey to go round and partly to the introduction of white crystalline sugar. Cheapness and easy availability are the factors which have secured preference for sugar in our dietary. The use of sugar has increased steadily and continuously, with the result that honey as a sweetening agent is neglected.

Modern researches into the dietetic value of honey have proved conclusively that it is an important dietary article for which white crystalline sugar* is a very poor substitute indeed. In this article it is proposed to discuss the various qualities and uses of honey with a view to repopularizing it in India.

What is honey?

Flowers of many plants secrete a sweet fluid, called nectar, from their glands termed nectaries. The bees visit flowers to gather this nectar which they store in a special portion of their gut, called the honey-stomach, and on their way back to the hive certain juices secreted by their glands act on the nectar and convert the sucrose† into invert sugars—glucose‡ and levulose§ which are easily and directly assimilable into the human system. The seasoned nectar is 'handed over' to the 'house-bees' who put it into the cells of the honeycomb in thin layers.

The bees then agitate the air in the colony by rapid vibrations of their wings, thereby setting up currents of air within the hive which evaporate the excess water from the honey in the cells. When the desired consistency of honey is reached, the cells are sealed. Beekeepers call such honey capped or ripe honey.

Thus, honey is a concentrated solution of sugars chemically called dextrose (glucose) and levulose (fruit sugar). In addition, it contains proteins, organic acids, enzymes, mineral matter, flavouring and colouring substances.

Amazing industry

It is estimated that 4 lb. of nectar are required to produce 1 lb. of honey and that 160,000 bees are required to perform this extraordinary work. Taking three miles to be the average distance that a bee has to fly to and from the source of nectar in order to collect enough to make one pound of honey, a bee will have flown over a distance equal to almost five times round the globe for the purpose. A worker bee collects about a dessertspoonful of honey in its lifetime.

The bees have a predilection for certain flowers, and once they have made their choice they keep on visiting the chosen flowers with

* Sugar is inferior to honey in many ways: (1) it is not in a readily assimilable form but has to be digested like any other food, (2) it does not contain proteins, mineral matter, enzymes, organic acids and aromatic bodies, and (3) it produces flatulence and acidosis in the stomach.

† Ordinary table sugar is chemically called sucrose and has to be converted in the human stomach into invert sugar to be taken into the blood stream. Honey contains invert sugar—glucose.

‡ Grape sugar or Dextrose—Dextr(right)ose, sugar.

§ Levulose—fruit sugar, Levu(left)ose, sugar which is directly assimilable. Sugar which deflects the plane of polarised light to the right is called dextrose and that which deflects it to the left is called levulose.

remarkable faithfulness and persistence until they are useless for their purpose. Thus the bees collect for us the sparkling honey from *sarson* (*Brassica comprestris* Linn. Var *sarson* Prain), soapnut (*Sapindus detergens* Roxb.) and barberry (*Berberis lycium* Royle.1).*

Chemical composition

The chemical composition of honey from different localities is given below :

	U. S. A.	Mahableshwar	Belgaum	Madras	Nagrota (Punjab)
Water (per cent)	17·7	19·62	22·94	14·89	15·43
Dextrose (glucose or grape sugar) (per cent).	34·0	30·08	27·15	73·96	35·4
Levulose (fruit sugar) (per cent).	40·5	41·37	39·77		41·8
Sucrose (per cent)	1·9	1·60	3·22	5·84	5·39
Ash (Silica, iron, copper manganese, chlorine, calcium, potassium, sodium, phosphorus, sulphur, aluminium, magnesium) (per cent)	0·18	0·21	0·83	0·47	0·30
Dextrin and gums (per cent)	1·50	*nil*	3·96	..	not determined
Miscellaneous (i) acids, (formic, acetic, malic, citric, amino, succinic), (ii) pollen grains, (iii) beeswax, (iv) pigments (per cent).	4·1	7·12	2·93	4·84	1·68

Honey is a natural product. It has as many tastes and colours as the varied flavours and colours of the nectars of different flowers from which it is derived ; no chemist can analyse this delicate flavour and fragrance of honey.

For example, honey from *Plectranthus*, soapnut, and white clover (*Trifolium ripens* Linn.) is light in colour and tastes like the smell of these blooms, that of *sarson* is yellow in colour and has the aroma of *sarson* flowers, and that from *shisham* (*Dalbergia sissoo* Roxb.) is dark amber in colour, its fragrance being difficult to define. Barberry and buckwheat honeys are very dark in colour with a strong flavour ; flavour of barberry honey is suggestive of molasses. Therefore, contrary to general belief, colour and taste are no indices to the purity and quality of honey.

* Rahman, Khan A. and Singh, S. (1940) INDIAN FARMING, Vol. I, No. 1, p. 10.

Nourishing power

Honey is a highly viscous liquid at ordinary temperatures, but during winter it usually granulates, i.e. forms into grains, and granulation in extracted honey is the best evidence of its purity. To bring granulated honey back to its liquid condition the receptacle containing it should be placed in *warm* water till it assumes its liquid state.

According to Pellett† 7 oz. of honey provide as much food value (i.e. the relative nourishing power) as the weights of the following :

Milk	$2\frac{1}{2}$ lb.
Cream cheese	5·6 oz.
Meat (Round beef steak) . .	12 oz.
Boneless codfish	15 oz.
Oranges	8
Eggs	10

Uses of honey

Honey is used for a variety of purposes. The following are its main uses :

It is used in religious ceremonies such as sacrifices and *pujas* by the Hindus. It is also given to a new-born babe for its purification.

It is used as a carrier for several types of medicines in the ayurvedic and unani systems of medicine.

It is used as a laxative.

According to the ayurvedic and unani systems of medicine its regular use prevents colds and coughs and makes one proof against fevers and many other ailments.

Honey is useful for sore eyes. For this purpose it is put in the eyes with a small zinc or glass rod dipped in honey.

It is a good blood purifier.

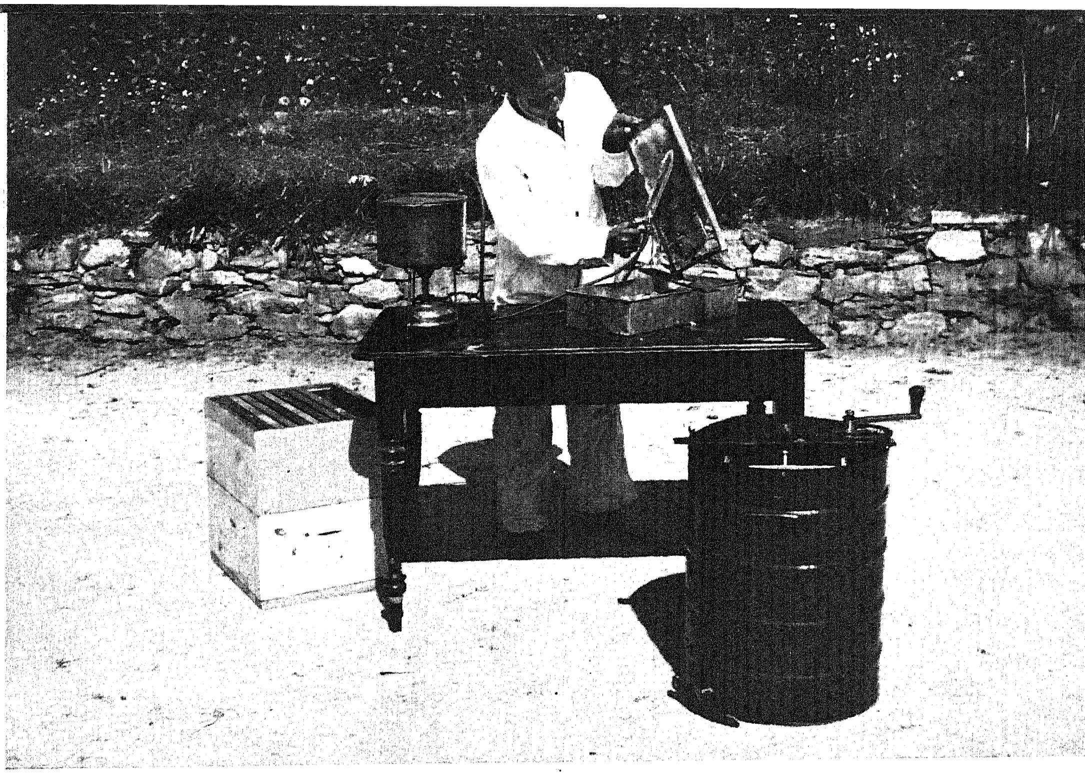
It is useful (when mixed with borax and glycerine) to cure ulcers on the tongue.‡

Dr Thomas§ of Edinburgh claims: 'In severe cases of malnutrition with heart weakness, I have found honey to have had a marked effect in reviving the heart action and keeping the patient alive. I had further evidence of this in a recent case of pneumonia...When the storage of sugar in the body is rapidly used up, I suggest that honey should be given

† Pellett, F. C. (1919), *Beginner's Bee Book*, Philadelphia.

‡ Schweizeris-ches Arzneiveror= dnungs—Buchlein.

§ Thomas, G. N. W. (1924) *Lance* 207 (5287): 1363.



Uncapping the honeycomb with a steam-heated uncapping knife. Note the uncovered super with frames full of honey to the left, and the modified (by us) honey extractor in front, of the operator. We have described this honey-extractor in a Bulletin entitled *Beekeeping in the Punjab* published by the Superintendent, Government Printing, Punjab, Lahore, for the Department of Agriculture, Punjab.

Placing the uncapped frame in the extractor

Removing frames with honey for extraction. Note (i) prying tool in the right, and smoker in the left, hand of the operator, (ii) pail of water with a brush across it, (iii) empty super (well-covered with cloth and top cover) for putting in frames with honey after each has been cleared of the bees, (iv) top-cover in front of the hive entrance, and (v) sheet of paper.

Bees hurled off the frame on to the paper by bumping right hand over the left.

for general physical repair and above all for heart failure.' Other medical authorities have confirmed these observations.

Lorand of Carlsbad and Nuttal of Los Angeles* have recommended honey for impaired digestion while Schacht† considers it to be an excellent remedy in serious and almost hopeless cases of stomach and intestinal ulcers.

Germs of such dangerous diseases as typhoid fever, dysentery‡, etc. die when introduced into honey: in fact honey is considered to be about the safest food from the sanitary point of view.

Honey as food

Honey is highly appreciated as food, specially for infants, the aged and invalids, both in this country and abroad.

It has been experimentally proved that honey builds haemoglobin in the blood of children.

Honey is a rich energy-giving food and in combination with milk forms a perfect food. This fact was given a practical test by Dr Haydak§ of the University of Minnesota. He lived on a honey and milk diet with occasional orange juice for twelve weeks, doing normal work without any ill effects on his health. He was under the supervision of a qualified physician during this period.

Since honey contains energy in readily

* Root, A. I. and E. R. (1935) *ABC & XYZ of Bee Culture*; pp. 463-4.

† Quoted by Alfonsus (1928) Am. Bee Jl. (LXVIII: 76).

‡ Sackett, W. G.—Bulletin No. 252 of the Colorado Agricultural Station, Fort Collins, Colorado.

§ Haydak, M. H. (1938) *Gleanings in Bee Culture*, LXVI: 624

available form, it is largely used by athletes after hard exercise or long races to recuperate their lost energy.* Any one who is tired or overworked can recover his stamina by drinking two tablespoonfuls of honey in a glass of water (hot in winter, cold in summer).

When used in bread, cakes and 'cookies', honey improves their flavour and keeping qualities†.

Uses in Indian homes

In an average Indian home honey can be used as follows:

In tea, coffee, milk and buttermilk in place of sugar. The drink to which honey is added acquires an attractive and delicate flavour.

Honey and curd form a good dish.

Honey and butter on bread, toast or biscuits taste excellent.

Honey-lemon drink.—Two tablespoonfuls of honey and a piece of lemon in a tumbler of water with ice makes a nice, invigorating drink, especially after strenuous exercise. Lukewarm water, instead of iced water, may be used in winter.

Honey-lemon tea.—Two spoonfuls of honey in a cup of hot tea, flavoured according to taste with lemon (instead of milk), make a nice drink. Iced tea can be used in place of hot tea during summer months.

Honey dissolved in water makes excellent *sherbet* which is particularly cooling and delicious in summer.

* Root, A. I. and E. R. (1935) *ABC & XYZ of Bee Culture*, pp. 401-2.

† Those interested in the culinary uses of honey are recommended to consult *100 Honey Helpings*, published by the American Honey Institute, Edison. Wisconsin, U. S. A.

F

What the Scientists are doing

GROWTH-PROMOTING VALUE OF EGGS

Though eggs are generally regarded as equivalent in nutritive value to milk, there is little accurate information in regard to the value of the former in the human diet, whereas the value of milk has been well established by numerous experimental workers. In countries where the standard of living is high eggs are freely consumed along with other valuable foods such as milk, meat and fish. In India, however, owing to poverty, the diet is usually very deficient in well balanced proteins and other essential vitamins and minerals. In *The Indian Journal of Medical Research* (Vol. 30, 2, April, 1942), A. J. Macdonald and S. Bose give particulars of four experiments carried out at the Imperial Veterinary Research Institute, Izatnagar, with the object of testing out the value of eggs in the diet.

In all the tests, two male and two female four-weeks-old rats were fed on each of the experimental diets for a period of 10 weeks. The basal diet fed to all the groups was that of the small agriculturists in the district of Dinajpur, Bengal. This diet containing only small quantities of pulses, vegetables and fish together with an unduly high proportion of rice may be regarded as typical of that consumed by a large proportion of the population in the rice-growing areas.

In all four experiments the Bengali diet gave very poor growth results. Further, the general health of the rats was poor and pronounced symptoms of vitamin A deficiency occurred in rats when fed on the diet for a period of 16 weeks.

With eggs as the sole supplement to the Bengali diet the best results were obtained with a diet consisting of 100 parts Bengali diet plus 50 parts eggs. However, somewhat better results were obtained with the 100 parts Bengali diet plus 50 parts eggs supplemented by 0·5 per cent of ground egg-shell. Though the 100 Bengali plus 50 egg plus egg-shell diet appeared to be very satisfactory from the nutritional standpoint of children, it cannot be regarded as a practical diet, for it is unlikely that human subjects would supplement their diet with calcium from egg-shells. Furthermore, to satisfy the necessary requirements for growth and maintenance in children from 6 to 9 years it would be necessary to consume over five eggs (each $1\frac{1}{2}$ oz.) daily, an amount which is beyond the reach of the majority of the population.

In a second series of experiments varying amounts of the egg supplements were replaced by soybean meal. The Bengali diets supplemented with soybean meal only did not give as good results as the Bengali diet supplemented with equivalent amounts of eggs. The Bengali diet plus $2\frac{1}{2}$ eggs daily plus soybeans, however, gave as good results as the Bengali diet plus 5 eggs per day. Supplements of soya in conjunction with eggs in addition to being economic had a practical advantage in that no calcium supplement was necessary with any of the soya supplemented rations. From the human standpoint the Bengali diet supplemented with 1·2 eggs ($1\frac{1}{2}$ oz.) and $2\frac{1}{2}$ oz. soybeans daily proved satisfactory from the nutritional and economic aspect for children from 6 to 9 years of age.

***

ANNATTO DYE

Annatto dye, or arnatto as it is very often called, is a vegetable-oil soluble dye commonly employed for colouring food-stuffs. Its principal use is for the colouring of butter, cheese, margarine and other edible articles such as chocolate. It is also used in dyeing silk fibre, to which it imparts a beautiful flesh colour. It has also been utilized to colour floor-wax, furniture and shoe polish, nail-gloss, brass lacquers, oils and wood stains.

Source of the dye

The dye is obtained from *Bixa orellana* Linn., the Annatto tree which is a native of

tropical America, where it is commonly found along the banks of rivers. The tree has long been cultivated in various parts of the tropics, including India, Ceylon and Burma, in which countries it thrives from sea-level to 2,000 ft. in localities with a suitable moist climate. The plant has become more or less naturalized in several places in Burma and southern India.

The Annatto tree is an evergreen quick-growing large shrub or small tree, which has cordate leaves and handsome white or pinkish flowers. Clusters of green, brown, or dark crimson capsular fruits are borne at the ends of the branches, green being the usual colour in the case of the pink-flowered, and brownish-crimson that of the white-flowered, variety of the tree. The ovoid or round capsules are clothed with soft fleshy prickles, and contain the annatto seeds, the bright crimson covering of which supplies the dye of commerce.

Preparation of raw product

The fruits are collected when nearly ripe, and as the capsules dry, they open and the brilliant seeds fall out, and are either ground up into 'annatto paste', or dried with their crimson covering and marketed as 'annatto seed'. Yet another common method of preparing the crude commercial product is to macerate the seeds with hot water until the whole of the pulp is washed off. The muddy liquor so produced is decanted through a sieve to remove the seeds. The liquor is allowed to stand and ferment until the insoluble colouring matter held in suspension settles down. The clear liquid is then decanted off and the wet paste dried in the sun. Prepared in this manner the dried paste or cake should contain 10 to 12 per cent of the pure dye and not more than 5 per cent of ash.

Plantations and yield

Bixa orellana is readily propagated from seed, and a crop may be obtained from the third or fourth year. The plant may also be raised from branch-cuttings from wood six months to one year old. A spacing of about 15 ft. × 18 ft. is recommended for plantations in Ceylon.

Annatto does not appear to have been grown as an economic crop in India, but it has been grown in many places as an ornamental garden plant. Thirty or forty years ago a few small plantations existed in Ceylon, and at one time a considerable quantity of seed was said to have been exported annually. In 1909, 263 cwt. of annatto 'seeds', valued at £307, was exported from Ceylon, but even before 1912 the demand for annatto was rapidly declining, and the product has long since disappeared from the list of Ceylon's exports. Macmillan (*Tropical Gardening and Planting*, 4th ed.) reports that the annual yield from mature trees is about 5 cwt. of seed per acre.

Annatto seed is still exported from South America, the United States and England being the principal markets. Before the war the market price was said to be about one shilling per pound.

Chemistry of annatto dye

Annatto dye contains two colouring matters, *orrellin* of a yellow colour and soluble in water, and *bixin*, a red crystalline substance very sparingly soluble in water but soluble in alkali solution and many organic solvents, notably in chloroform. Besides these two dyestuffs, it also contains a waxy substance, a resin and a bitter principle. Bixin is by far the most important constituent, and is present to the extent of 2 per cent on the weight of the seeds. For its isolation the dried annatto seeds or paste is extracted with boiling chloroform for about 24 hours, filtered and the chloroform is recovered. The residue is thoroughly exhausted with petroleum ether to remove waxes, oils and other matter. The product left over when crystallized from chloroform yields crystalline bixin m. p. 191°C.

Colouring 'Vanaspati ghee'

In order to distinguish pure ghee from 'Vanaspati' (hydrogenated oils), the latter has to be coloured deep yellow in accordance with law, which is being enforced in certain provinces in India. For this compulsory colouring of 'Vanaspati' synthetic dyes orange D & E, are recommended; but there is opposition to their use on account of their possessing toxic properties. Hence the need for discovering an acceptable dye for colouring 'Vanaspati'.

Experiments at Dehra Dun with the annatto

dye prepared from the seeds obtained from Orissa showed that 'Vanaspati' ghee could be coloured to the required depth (30 yellow and 32 red in a 2 in. × 1 in. × ½ in. cell on a Lovibond tintometer) by either (i) 0·37 per cent (on the weight of the fat) of the annatto dye, or (ii) 0·17 per cent of pure bixin. Thus 0·28 lb. of the dye would be needed to colour 80 lb. of the fat.

Effect on human system

Whether or not the above small quantity of annatto and its daily consumption has any toxic effect on the human system it is not possible to say in the absence of pharmacological tests, but it will not be safe to draw any inference as to its toxicity merely from the fact that it is already in use for the colouring of butter, for which purpose only three to four drops of the dye solution suffice to give the desired yellow tinge to a pound of butter.

Little is known regarding the application of annatto in therapeutics, though the pulp of the seeds is recorded as a cordial astringent and febrifuge (Kirtikar and Basu, *Indian Medicinal Plants*, 1933, 2nd ed., pp. 217). The bixin-free resinous material of the seeds is reported to be one of the richest sources of vitamin A (Cook and Aximayer, 1932, *Science*, **75**; 85). They also contain vitamin D (Bachsten and Covalline, 1935, *Chimie. e. industrie*, **17**; 650-1). Another worker has found that the peel of the seeds contains 3 per cent of a wax-like substance of strong paralytic action to internal parasites and that the embryo contains a poisonous principle of drastic action (Freise, F. W., 1935, *Pharm. Centralblatt*, **76**; 4-5).—*Note by the Forest Research Institute, Dehra Dun.*

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. What are the most useful methods of combating preventible microbial diseases ?

A. Sera and vaccines are widely used to combat preventible diseases. Serum is more useful as a protective agent, when compared with a vaccine, in so far as it gives an immediate and rapid protection, while that given by vaccines takes a few days to become established. The disadvantage, however, in the use of serum is that its effect lasts for only a few days, and repeated injections are required to tide over an outbreak when the disease is raging in the immediate vicinity.

The use of vaccines, on the other hand, confers a solid and lasting immunity which, although taking 7 to 15 days to be produced, lasts for at least six months to a year. It is, therefore, advisable to vaccinate systematically once a year without waiting for the appearance of the disease. By following this method many of the losses from infectious diseases can be prevented.

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Q. What are the curative and therapeutical effects of sera and vaccines, and when should they be used or not used in the treatment of disease ?

A. The effect of serum therapy is much more certain if the serum is given early and if a large dose is given. One should not expect a serum to cure a very violent attack of the disease on an animal which has been treated too late. Once the disease has shown itself in the animal, vaccines are not likely to be of much use except in chronic, mild or localized infections such as, for example, boils on the skin. It is often better to prepare vaccines for these purposes from the animal in question and these are then spoken of as autogenous vaccines.

Q. Please give me information on the different uses of milk and its by-products with special reference to skim milk. How can they be used to the best advantage ?

A. According to figures recently worked out, in market cream business and in creamery butter manufacture, separated milk is most profitably converted into sweetened condensed skim milk. The alternative is to make skim milk powder.

In ghee making, the *desi* method is most unprofitable. Cream ghee process yields the highest return if the skim milk obtained is used for making sweetened condensed skim milk. The same applies to cream butter ghee process. The cream ghee process gives the highest return in all combinations when compared with the other two methods of making ghee.

Manufacture of *khoa* is not profitable. *Dahi* fetches more than market milk. Cheese making is more profitable than making *khoa* or *desi* ghee.

Condensed whole milk and whole milk powder give a good margin of profit.

On a small scale skim milk is best sold as fluid milk for liquid consumption. It may also be used for making low-grade *khoa*, curd, cottage cheese, etc. The practice of using skim milk for *toning* rich milk or adulterating milk is not uncommon in this country. The latter is to be deprecated.

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Q. I want to open a dairy in Benares and keep cows and she-buffaloes. Please let me know where I can get full information on dairying and what books are useful.

A. There is no book which describes fully and properly the organization of a dairy

business, but you can get advice from the Director of Dairy Research, Bangalore. For gaining a general idea of what is involved in the management of cattle and dairy business the following books, which can be had from any good bookseller, are recommended :

Manual of Indian Dairy Farming by B. K. Ghare (Macmillan & Co., Bombay. 1921)

Milk Production and Control by W. C. Harvey and Harry Hill (H. K. Lewis & Co., Ltd., London)

Indigenous Dairy Products by W. L. Davies (Thacker, Spink and Co., Ltd., Calcutta. Rs. 2-8.)

Milk and its Products by Henry H. Wing (Macmillan & Co., New York. 1913)

What's doing in All-India

MADRAS

By T. VINAYAKA MUDALIAR, G.M.V.C.
Superintendent, Livestock Research Station, Hosur Cattle Farm P. O.

CHINNABELA-KONDAPALLI, in Hosur taluka, Salem district, was *en fête* on 15 January. People woke up prepared for a day of fun and frolic. It was the *Mattu Pongal* or the annual cattle festival. But this year it was celebrated on a grand scale, as the village was sending some Hallikar bulls to the All-India Cattle Show at Bangalore. Flags and festoons were much in evidence and the village band was in attendance. The cattle were all washed and their horns painted. Cows in particular had a little make-up—saffron paste and red marks on the face, forehead, back, and tail. They were all fed well, with specially cooked rice and jaggery, after the usual offerings to God. The animals were then garlanded and driven through the village streets. Bull-baiting on a small scale was also conducted.

Livestock officers were there to take part in this village function. Their presence elated the village folk a good deal. People from neighbouring villages also were gathered in large numbers. The village square presented an animated appearance when the show animals were brought in. A timely lecture on livestock improvement was delivered and was much appreciated. As people are more particularly ' cattle-minded ' on that day, such intensive propaganda in as many villages as possible seems to be indicated. The animals for the show were then taken round in procession and they left the village to the strains of village music and the blessings of the village folk. One of the animals got a prize at the show.

Livestock scheme

The Government of Madras allocated Rs. 50,000 for improvement of livestock from the Government of India grant for Rural Development in this province. The following scheme was approved and the work put in hand :

1. To purchase and distribute adult breeding bulls.

Twenty-five Sindhi bulls (for urban areas and the West Coast), 45 Kangayams, 20 Hallikars, 20 Ongoles, and 100 Bikanir rams (for sheep-breeding tracts of woolly type) were purchased and distributed in the respective breeding tracts.

2. To purchase and distribute young bulls of about 1½ years of age to be reared by suitable ryots and then used as stud bulls. Rs. 50 will be paid for two years for each bull towards its maintenance.

Under this head 20 Kangayams, 15 Ongoles, and 50 Murrah buffaloes were purchased and distributed. Fifty more young Murrah buffaloes are being reared at the Hosur Cattle Farm to be sold after two years at concessional rates to ryots.

3. Certain conditions are laid down. Those are, that the bulls should be well maintained and well housed, and should serve at least 120 cows each within a period of two years. A service record should be maintained on prescribed lines and the animals will be subject to inspection regularly by the veterinary staff.

4. If the conditions are fulfilled satisfactorily the adult bulls become the property of the custodians at the end of two years.

5. In the case of young bulls, they will be reared for two years as stated above and then maintained on the same conditions as adult bulls by the ryots who have reared them.

6. The recurring charges towards the maintenance of the young bulls and buffalo bulls will be met from provincial funds.

7. It is hoped in course of time to build up a Livestock Improvement Fund and to purchase

and distribute bulls and rams annually in the chief breeding tracts in the province.

Foot-and-mouth disease

A severe outbreak of foot-and-mouth disease occurred at the Hosur Cattle Farm recently and some of the facts noticed are recorded here.

It was the end of October, 1941, when the disease is not generally expected. And yet, on the 30th it was suspected in a few cows which had to cross a public road to get into a paddock on the other side for grazing. Enquiries revealed that this disease was not prevalent then in any of the villages within a radius of six miles. The disease was confirmed on subsequent days and with barely 10 weeks for the All-India Cattle Show at Bangalore, the best means had to be found for combating this outbreak. Infected saliva from affected animals was freely applied to all the other animals. They were allowed to mix freely. The disease spread quick and out of 815 animals on the farm, 750 animals or nearly 92 per cent got the disease.

It was noticed :

(1) That the disease was more severe in Kangayam and Hallikar breeds of cattle than in the Sindhis.

(2) That suckling calves under one month of age died from the disease, showing severe ulcers in the stomach and intestines. The older calves did not die.

(3) Of the 13 calves that died, 7 were Kangayam, 5 Hallikars, and 1 Sindhi, though the total number of calves of that age under each breed was about the same.

(4) The female stock suffered more acutely than the male stock.

(5) Change of coat followed only in female stock and not in the male stock.

(6) As many as 65 Kangayams, 11 Hallikars and 13 Sindhis changed their coat.

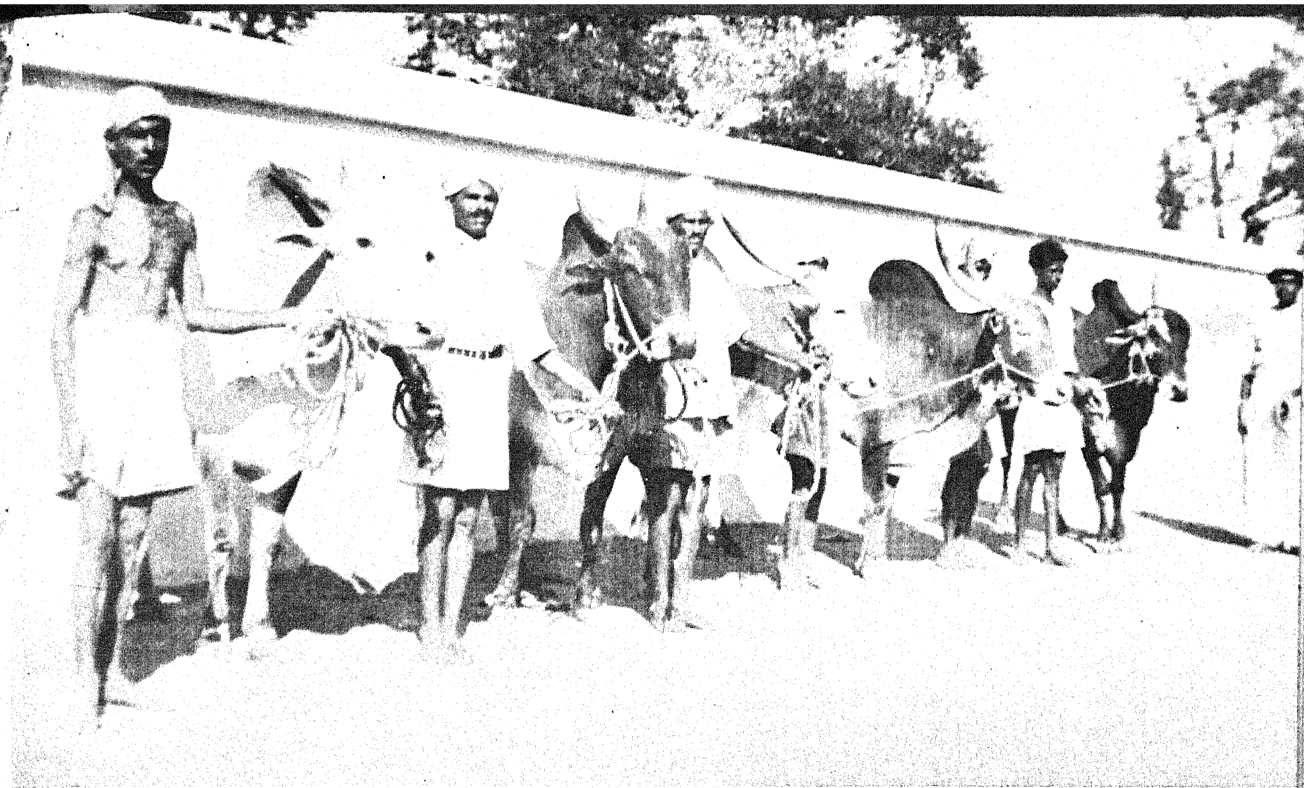
The milk-yield of some of the badly affected cows after their calving is under study and will be recorded later.

UNITED PROVINCES

By C. Maya Das, M.A., B.Sc. (Edin.), I.A.S.
Director of Agriculture, United Provinces, Lucknow

UNDER a scheme financed by the ICAR the Agricultural Department has been carrying out investigations at the Bharari farm near Jhansi regarding the effect of green berseem on the growth of Hissar and Murrah heifers. This was compared with a mixture of concentrates consisting of linseed cake 50 parts, wheat bran 20 parts and barley 30 parts. The protein requirement of one group was supplied through the mixture of concentrates while the second group received half from concentrates and the other half from berseem. Similarly, three-fourths of the concentrates were replaced by the berseem for the third group. It was found that the average rate of growth for the three groups was 0·65, 0·51 and 0·52 seers per day respectively with the Hissars; and 0·73, 0·55 and 0·50 seers per day respectively with the Murrah. From this it would appear that the growth rate by replacement of concentrates is satisfactory. The average cost of the total feed for a 100 seer increase in live-weight with the three rations was Rs. 33-10, Rs. 29-6 and Rs. 21-1 for Hissars and Rs. 28-10, Rs. 26-10 and Rs. 24 for Murrahs. It is satisfactory to note that the feeding requirements of animals can be met at lower cost with partial replacement of concentrates by berseem. Results show that for growing animals one seer of the above-mentioned mixture is equivalent to 8·5 seers of green berseem.

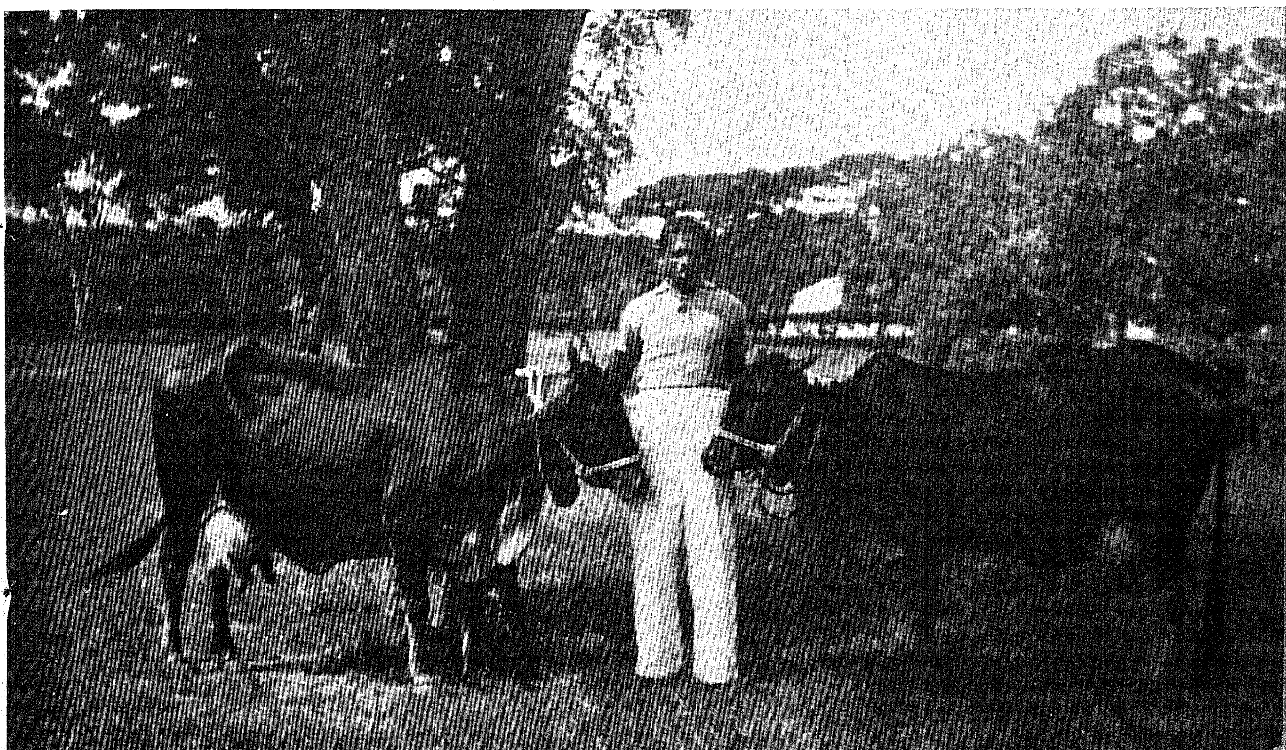
As a result of further feeding trials it was also found that the milk-yield of a cow is not materially affected even when three-fourths of a good concentrate mixture consisting of 10 parts of linseed cake, 10 parts of groundnut undecorticated cake, 10 parts of *til* cake,

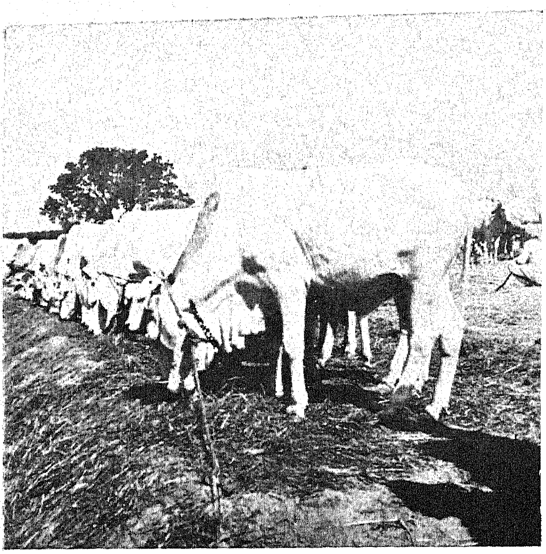


Hallikar bulls for distribution in Madras for livestock development

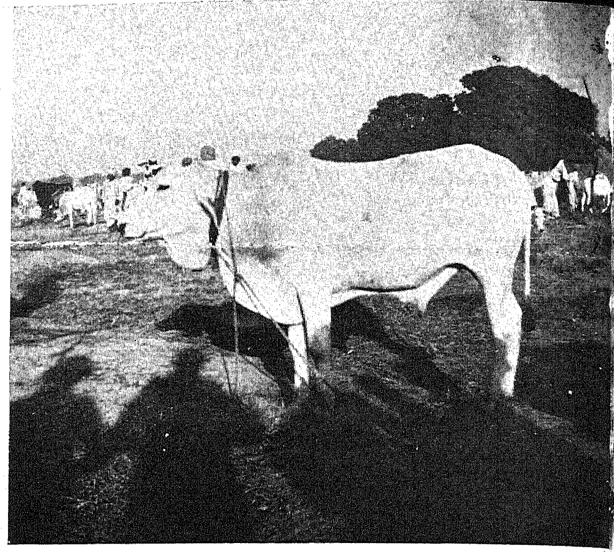
Two prize-winners at the Bangalore show :
(Right) Sindhi cow 143—the best Sindhi cow in the show
(Left) Sindhi cow 132—the highest yielder of milk

PLATE



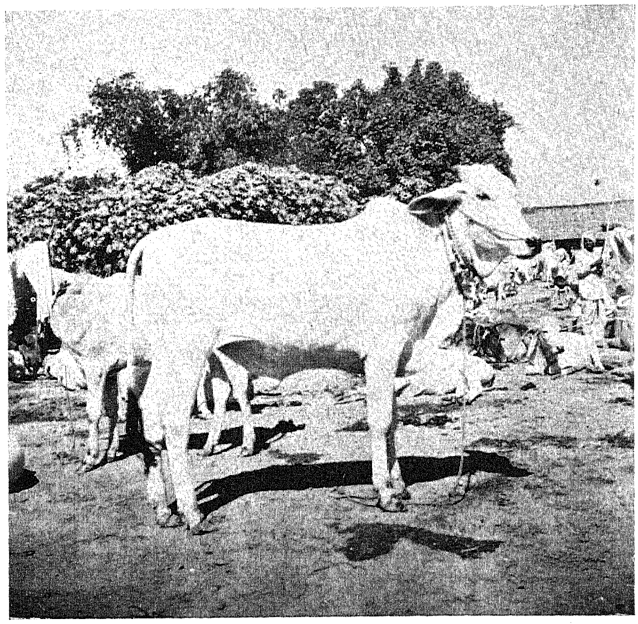


A herd of young Hissar calves from the Punjab

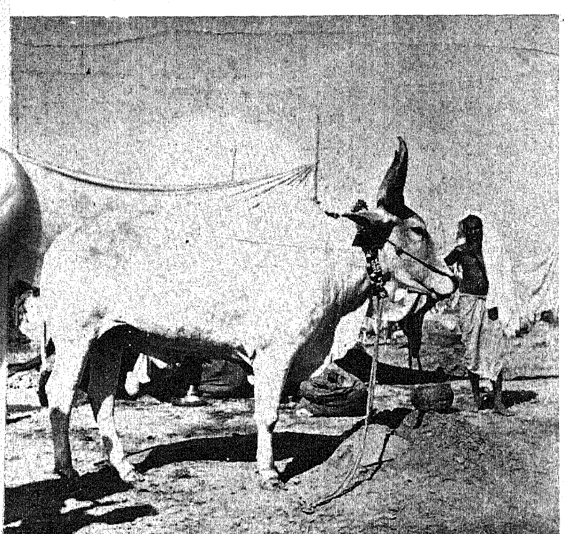


A Purbi bullock

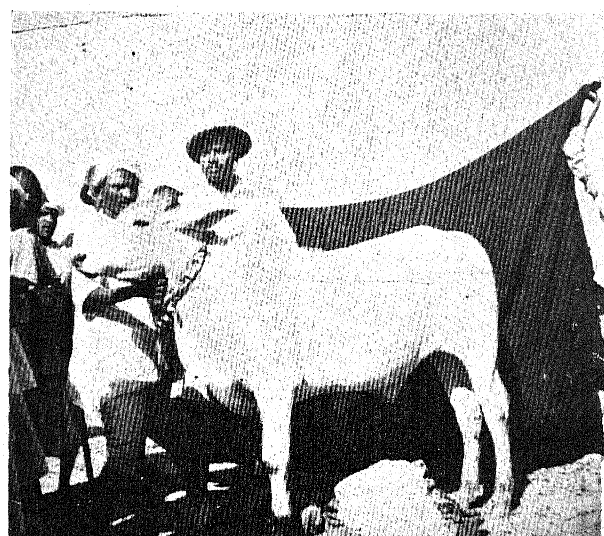
PLATE 79



A Hissar breed bullock bred in Ballia district (east U.P.)



A Chambli bullock



A cross-bred bullock from a Hissar bull and local cow

20 parts of bran, 35 parts of barley and 15 parts of gram is replaced by berseem. The replacement is also economical as berseem can produce nearly the same quantity of milk as the concentrates at a lower cost without appreciably affecting the composition of milk. It was found that one seer of this concentrate mixture is equivalent to 6·5 seers of green berseem for the production of milk.

Promising early canes

Research on the sugarcane crop continued at Shahjahanpur, Muzaffarnagar, Gorakhpur and Kalai. Three promising early varieties of cane namely Cos 109, Cos 146 and Co 527 were released to the cane-growers in the central and eastern tracts of the United Provinces. At the Muzaffarnagar farm Co 453 and Co 545 have given a satisfactory performance among the standard trial varieties. These have given equally good results at Shahjahanpur and Gorakhpur. Another mid-season variety, i.e. Cos 196 promises to be superior to Co 312, the standard cane of the western tracts, both in yield and sucrose content. At the Kalai farm, *gur*-making trials were conducted towards the end of the quarter on the selected varieties in the final trials. Co 313, Cos 109 and Co 527 maintained their reputation for giving high recovery of good quality *gur*.

Agronomical and entomological observations on both the provincial and ICAR ratoon experiments on the Kalai farm showed that during the early part of the quarter pyrilla incidence was on the increase, but registered a decline towards the end. White-fly incidence was noticed more on ratoons than on planted cane. The maximum damage to sugarcane by termites was noticed in the month of November. Generally speaking, most of the cane pests showed reduced activity towards the close of the quarter under review, due probably to lower temperatures.

Hill potatoes introduced

In the eastern agricultural circle, the introduction of hill potatoes among the cultivators was attempted with success. The importance of growing hill potatoes was impressed on big zemindars and cultivators. The demand for potatoes has increased on account of the war. This affords a good opportunity to the cultivators to introduce a paying crop into their rotations. About 230 md. of Katwa (hill variety) seed was purchased from Dehra Dun and issued to the growers. It is expected that the quantity supplied to the cultivators will cover an area of about 30 acres of land, and estimating the average yield at 150 md. per acre, the cultivators are expected to harvest about 4,500 md. of potatoes. In addition to hill potato introduction, the demonstration and propaganda staff of the eastern circle conducted 15,079 field demonstrations and 8,270 manurial trials. They issued 101,710 md. of *rabi* seed and sold 457 ploughs, 170 hoes and 322 other implements.

Dadri fair

The Dadri fair in the Ballia district is the most important in the eastern part of the province. The fair owes its origin to the great saint Bhrigu and to the Dardar *rishi* who resided at the confluence of the Ganges and the Sarju rivers. The rivers keep changing their courses but the fair is held at the original site as nearly as is possible. The fair, though religious in origin, now derives its importance from its commercial aspect and thousands of people from far and near flock to it to bathe and to make purchases of cattle and horses.

The fair is held annually on the full moon of *Kartik* and is visited by about half a million persons from all over the province. It lasts for a fortnight and there is a brisk sale of cattle. About 50,000 cattle, most of them young draught animals, and 5,000 horses are sold every year. The Agricultural, Veterinary and Rural Development Departments have contributed to the success of the fair by holding exhibitions on the spot every year.

The sale of livestock is the main source of income at the fair. The total income from this amounts to over Rs. 20,000. A large majority of the livestock comes from the eastern districts and Bihar, though some cattle also come from the Punjab. The introduction of good breeds of cows in the Ballia district and into Bihar is due chiefly to the two important fairs of Harihar Chetra at Sonepura (Bihar) and the Dadri fair in the Ballia district (United Provinces). The cattle

originally imported from the Punjab, west United Provinces and Rajputana were introduced in the tract through the Dadri fair.

Check on profiteering

The rapid multiplication of seed and extension of areas under the varieties Perso-American and C520, particularly in the western parts of the province, has engaged the attention of the Department of Agriculture. An area of about 5,500 acres was covered by Perso-American, and 7,250 acres were under C520 during the last *kharif* season. In order to secure the maximum value of the two qualities for the growers, four cooperative unions were set up in the main cotton-growing centres in order to minimize profiteering by the middlemen.

Arrangements have been made to see that both the financial and agricultural aspects are kept in view by the cooperative unions since neglect of either will prove suicidal. The *kapas* was purchased by the Department at a premium of 8 as. and Re. 1 respectively for C520 over *desi* and Perso-American over the American type available in the different markets. Enough seed for sowing four times the present area under improved cottons has been secured for distribution to the cultivators next year.

Side grafting of mangoes in the gardens controlled by the Agricultural Department is being done every month to see which month is the best. It seems at present that the cooler months of September and October are better than July and August. Vines were pruned early to force early ripening, but results this year were inconclusive. Cinchona seed received from Ootacamand was sown but did not germinate. Useful data on alternate bearing of mangoes were recorded during the quarter.

BIHAR

By B. P. Akhaury, B.Sc. (Wales)
Deputy Director of Agriculture, Tirhut Range, Pusa

With a view to making the province self-sufficient in food grains, the Government has launched a 'Grow More Food' campaign through the Agricultural Department.

Bihar has nearly 24 million acres under cultivation to feed a population of about 40 millions. As the whole of the area is not devoted to the production of food crops, this province imports about 54 lakh maunds of food grains every year from other provinces.

Food production drive

The soil of Bihar is in general quite fertile and capable of giving a richer harvest than at present. It may be asked, Is there anything wrong with the cultivators? No, because they are industrious and resourceful. If the soil and tillers of the soil are all right, then what is wrong and what is needed? All that is needed in the present emergency is leadership to guide the people in the right direction and then there is no reason why the problem cannot be solved within the coming seasons—*bhadai*, *kharif* and *rabi*.

On the basis of the last *kharif* and the present *rabi* harvests, the province will need approximately an additional 8,100,000 md. of food grains to meet its normal requirements. Our aim should be to produce this extra and some more in order to safeguard against the rainfall hazard as our cultivation depends to a large extent on rainfall, which is beyond human control.

How can we do this? Long-range measures or projects can only be counsels of perfection at this time and not a practical solution. So what is needed is short-range measures which can increase the food supply within the coming seasons.

Inexpensive solution

Methods of solving this problem have been indicated by the Director of Agriculture, Bihar.

The underlying idea is that no additional expenditure, beyond his own labour, should be caused to the average grower and that his ordinary routine of cultivation should not be upset.

The main food crops of Bihar are rice, maize, wheat, barley, gram, and *arhar*.

The first five are the main food grains and the sixth—*arhar*—is the main pulse used. We produce more than enough of *arhar* and the problem therefore is to produce more of the first five.

Rice

The total area capable of growing rice (both autumn and winter) is some 10 million acres. On an average the yield is 8 md. per acre of autumn rice (not paddy) and 10 md. per acre of winter rice. This yield can without doubt be increased by 20 seers per acre which will mean an extra production of 50 lakh maunds over the whole area by cultivating every inch of the rice area and conserving every drop of water, the most essential requirement of the crop. The cultivator is advised to repair all pynes, *ahars* and other storage reservoirs and not to have water running through paddy fields during the crop-growing season. This is not only a very wasteful practice but it deprives other cultivators of this very important commodity. In canal-irrigated areas the wasteful and useless practice of *nigar* is to be stopped. This does no good and in years of deficient rainfall is definitely harmful. The water so saved will enable some other cultivators to get a better outturn.

In unirrigated areas *ails* and field *bunds* should be repaired so that rainfall is not wasted.

The land should be manured with whatever the cultivator can afford. All available cowdung cannot be used for this purpose, as some must be kept for fuel purposes. At least a half of the supply can be reserved for manure and the ashes and other household refuse put on the land. All vegetable waste such as dry sugarcane leaves, left over fodder, etc. can be used in making compost. Those who can afford it should use 2 to 3 maunds per acre of such cheap cakes as *neem*, *karanj*, *mahua* and in this work the cooperative societies can play a very valuable part by making advances for these manures.

No fancy or fine types of rice. These as a rule give low yields. Medium or coarse types that always give better yield should be grown. What we want is quantity.

These simple and practical measures will certainly give an extra yield of 20 seers per acre which will mean an extra 50 lakh maunds over the total rice area.

In the districts of Purnea, Darbhanga, Champaran, Muzaffarpur, Bhagalpur and Santhal Parganas we have 282,000 acres under jute. The demand for this fibre is going to be much less than in the past and the prices are also not going to be attractive in the coming year. Cut down this area by at least half and thus get an additional 140,000 acres of valuable paddy land which will yield 14 lakh maunds extra. In some areas a crop of rice is taken after jute but the yield is never the same as when only rice is grown. What is the use of growing a fibre crop for sale when the sale proceeds are not likely to buy food if it is scarce? Grow food and reduce the area under jute.

Maize

There are 1,639,000 acres under maize. In North Bihar and in parts of South Bihar the land on which *arhar* is grown is also the soil on which maize can be grown successfully. This area is estimated at 204,500 acres. Without in any way reducing the area under *arhar*, maize can be grown if only the cultivators will grow the two crops in alternate lines. By this method not only is labour saved in weeding, etc. but what is most important at least 10 lakh maunds of extra maize grain at 5 md. per acre will be obtained, not to speak of maize fodder for cattle, without in any way affecting the *arhar* crop. It has been established that *arhar* when sown in lines gives a better yield than when sown broadcast. Any cultivator who grows *arhar* in these areas and does not grow maize in the manner stated above is definitely doing harm to the province.

In parts of South Bihar, where soil is heavy clay and maize cannot be grown, another valuable food crop that can be grown in alternate lines is *jowar*.

Wheat

The average area under wheat is 1,180,000 acres. During the current season there were approximately 13 lakh acres under wheat with an estimated yield of 130 lakh maunds. The extra acreage is due to a smaller area under sugarcane and better prices for the grain. Wheat prices are going to remain attractive and every effort should therefore be made not only to maintain the present season's area but to increase it. The increase in area can be achieved in the following manner.

In North Bihar there are usually 260,000 acres under linseed in a year. Most of this land is fit for wheat. There is extremely little demand for linseed which gives only 4 to 5 md. per acre and which rarely sells above Rs. 3 per md. in the primary markets. On the other hand, wheat yields not less than 10 md. per acre, it is near 12 md. and the price is very attractive. The linseed area should therefore be reduced by at least 66 per cent. This will mean that the province will have 180,000 additional acres under wheat, which means at least 18 lakh maunds of additional wheat—a very important and welcome supplement to the food resources of the province.

Gram

The area under this important food crop is some 1,564,000 acres with a yield of about 127 lakh maunds. In years of good harvest an appreciable quantity of this grain is exported. The grain is an important article of diet. It is wholesome and very nutritious and every effort should be made to extend its cultivation. This can be done in the following manner.

In South Bihar there are some 2 lakh acres under linseed. Almost all the lands on which linseed is grown are admirably suited for growing good crops of gram. Restrict the area under linseed and grow gram on at least 125,000 additional acres. This will mean some 16 lakh maunds of extra food, a most welcome addition.

If the above suggestions are adopted we shall have within the coming seasons an additional 108 lakh maunds of food grains which will be more than sufficient to meet our requirements.

Citizen's duty

In addition to the cereal crops mentioned above, every cultivator should grow the following on his homestead lands and any odd bits of land that carry nothing at present. The crops suggested are easy of cultivation, yield within one year and will form a very valuable addition to the food resources of the province:

(*a*) Papaya—valuable fruit and vegetable, yields within 8 to 10 months.

(*b*) Banana—valuable fruit. Yields within 12 to 18 months.

(*c*) Beans—of all sorts—valuable vegetable both nutritious and satisfying.

(*d*) Sweet potatoes—a very valuable food crop easily grown. A few plants will produce a useful addition to the food requirements of the family.

(*e*) Vegetables of all sorts—essential for health.

And above all conserve food resources:

(*a*) By eating home-pounded (*dhenki* pounded) rice in preference to mill-polished rice. *Dhenki*-pounded rice is much more nutritious than mill-polished rice and a smaller quantity of it is needed to satisfy one's requirements.

(*b*) Eat less rice, more vegetables and dishes made out of gram. This latter is far more nutritious.

(*c*) Eat more maize. This is a very nourishing food.

(*d*) Eat more barley. It is no less nutritious than wheat and is more nutritious than mill-polished rice. The increased use of barley will help in reduced consumption of rice and wheat.

(*e*) Eat gram and more gram. It is a national duty to do so. Its preparations are tasteful and nutritious.

(*f*) Don't pick and choose. Make the best use of the local resources and help in getting over the difficult times that face all of us.

COCHIN

By M. SANKARA MENON, B.A., B.AG.
Economic Botanist, Cochin State, Trichur

RICE is the most important crop of the state and the chief article of food. The area under rice is 215,500 acres and the average production is about 143,700 tons of paddy. This is sufficient for the population for about five months of the year. For the remaining seven months the state is dependent on rice imported chiefly from Burma.

The recent developments in the Far East have had their serious repercussions on our food supplies. Since the fall of Rangoon and the occupation of parts of Burma by the Japanese, supplies from Burma have been entirely cut off and there are no arrivals of rice at the port of Cochin. The merchants too are not keeping any large stocks on account of the war scare; on the other hand they are only too eager to dispose of what they have. The result is that the state is faced with a serious shortage of food.

Food production drive

The Government of Cochin has taken immediate steps to improve the food position. A scheme for augmenting food production has been inaugurated. All Government land available in the shape of forest exclusions or Sirkar *porombokes* under the Revenue Department is to be immediately released for cultivation. Land in private possession which is fit for cultivation but not actually cultivated is to be compulsorily cultivated with useful food crops.

The Government land is to be leased out for three years at very low rates and the ryots are to be accorded preferential treatment when the question of assignment of the land is taken up by the Government. Advances up to Rs. 15 per acre are also to be given in cases of necessity to enable the ryots to start cultivation immediately, and the Government has set apart a sum of Rs. 25,000 for the purpose. The advances will be repayable at the time of the harvest. In order to encourage cultivation and increase the output of rice the charges on occasional double crops will be remitted by the Government for the duration of the war.

The Agricultural Department is to make advances of seeds and plants in deserving cases. A sum of Rs. 5,000 is placed at the disposal of the Department for this purpose. The Department is also to carry out vigorous propaganda and to give advice and help to the ryots in the cultivation of the new areas.

Expected increase

For the project a special staff has been appointed. The staff consists of a Commissioner of Food Production assisted by two Tahsildars and a dozen village officers. The staff has already commenced work and it is expected that with the active help and support of several agencies and Departments concerned and the willing cooperation of the cultivating classes a substantial increase in production will be effected in the near future.

Next to rice, the important crops that are to be pushed are tapioca, millets, vegetables and bananas. Tapioca is the poor man's food of the West Coast and its cultivation has received much attention in recent years. It is a crop easy of culture and at the same time it gives a large amount of starchy food. At present the area under tapioca in the state is only 3,000 acres and the yield about 10,000 tons of tubers. A vigorous campaign has already been started, and it is expected that during the coming season the area under tapioca will be considerably enlarged, and the production increased four to five times.

The Month's Clip

WHAT'S IN A PEDIGREE?

By Dan Knowles

Is a Pedigree of any value? If so, what is that value and to what use can it be put? Some will say it has none, and that it is a worthless scrap of paper. Others may regard it with high esteem, but know little of its real worth. But the intelligent breeder who knows how to read it can extract from it a wealth of knowledge to be used in producing the best of line bred stock.

I once called on a prominent breeder, intending to buy some stock. When I approached the subject of a pedigree, he gave me the Ha! Ha! and said a pedigree meant nothing, and, being a mere scrap of paper having no value, it was a worthless thing. Needless to say, he lost a sale which he could easily have made. Later, at one of our Fairs, he further ridiculed me and 'those worthless pedigrees!'

It is true that a pedigree may be a very worthless thing (many sent to me have been just that) and contain very little information. Pedigrees are worthless when the makers either do not have the information, or are ashamed to give it. Still, it may, and should, contain a wealth of information; it all depends upon the maker of the pedigree, his honesty and knowledge of the records it should contain.

There are six things a pedigree should contain, namely: names, numbers, milk and butterfat records, prizes won at Fairs, horned or hornless, imported stock.

Let us take these up in order and point out the value of each:

(1) Names. Goat names should be simple, attractive and easily pronounced. To many of us a lot of unpronounceable names would make a pedigree very unattractive. Long names should be avoided, as they present a difficulty when writing them in the spaces provided in registration certificates, pedigrees and service memorandums, as well as being hard to remember.

To illustrate the value of short names: a certain man was introduced by a friend to one of his business colleagues; meeting this man again the next day, he was somewhat embarrassed when he could not remember his name. Not wanting to expose his short memory, he said: 'How did you say you spelled your name?' Whereupon, the newly made friend replied, 'S-M-I-T-H.'

On request, a breeder sent me a fine pedigree, with a number of pretty names on it, with the customary numbers. Now nice names add value to a pedigree, for every one likes them, but a goat can have a very fine name, and yet be a poor producer. Names have the least value of the six qualities that should be contained in any record. So far as being of value to me in choosing a goat for milk production, show quality, breeding value, etc. this pedigree was worthless. It did not name one thing of value—so he lost the sale.

(2) Numbers. Numbers are necessary to identify the animal, and to enable one to trace the ancestry. Every breeder should know the ancestry of the particular goats he is breeding.

(3) Milk and butterfat. Not only should a breeder know the ancestry as to name and number, but also what they were as to producers of milk and butterfat and their prepotency in passing on their good qualities to their sons and daughters. Every pedigree should contain the milk records of each doe in the pedigree. If these records are Advanced Registry, so much the better for these can be depended on, while others depend on the sincerity and honesty of the breeder. Some one will ask where this information can be found. By the intensive study of many pedigrees and Advanced Registry records in herd books of the registering association.

(4) Prize-winners at fairs. If the pedigree contains the record of prizes won at exhibitions, it will enable one to know the winning ability

of that particular strain of goats. This of course is important when one desires winning ability along with milk production.

(5) Horns. No one likes horns, yet many breeders pay little attention to this. It should be noted on the pedigree, to enable one to breed for hornless animals.

(6) Imported stock. To be of the most value a pedigree must run back to the imported stock so as to ascertain the degree of relationship, and which imported animal or animals were the progenitors. The importance of this is pointed out when one realizes that certain individuals have been great producers and have had the prepotency to pass this valuable quality on to their progeny. Therefore every breeder should know all the imported stock of the particular strain he is breeding.

After all this has been learned, buy your foundation stock from a reliable breeder who line breeds and has proved that he knows his business by the number of high producers and show record individuals in his herd.—*The Goat World*, January 1942.

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MINERAL SUPPLEMENTS

IT behoves every farmer and ranchman to see that his animals receive all the minerals that they need; otherwise no livestock stands a chance of paying maximum dividends. For this reason every stockman should be thoroughly acquainted with the kinds and amounts of minerals his stock actually need in their diet, which of these minerals are present in feeding stuffs commonly fed, which of them must be added in the form of mineral supplements, and which of them need not be supplemented in any form.

Salt is essential

One of the most important minerals in livestock feeding is common salt. This mineral is not found in appreciable amounts in most livestock feeds; accordingly, it must be fed to stock as a supplement. It may be supplied as a lick, alone or mixed with other minerals, or it may be mixed with ground grains or other ground feeds. Generally, when feeding dairy cattle one per cent of salt is included with the concentrates, and for hogs one-quarter to one-half pound of salt may be included in every hundred pounds of feed mixture.

In the continued absence of salt in their rations, animals are apt to become unkempt in appearance and generally unthrifty.

Calcium and phosphorus requirements

Two other minerals that are needed in fairly large amounts by animals and that may be lacking in many feeds are calcium and phosphorus. The needs for these minerals are especially marked for young growing animals, for reproducing females, and for high-producing dairy cows, because they are necessary for the manufacture of bone and also are components of milk. The lack of either or both of these minerals in the feed of growing animals will result in rickets with its malformations of the skeleton, often seen as knotty joints and crooked leg bones. When mature animals receive insufficient amounts of these minerals the animal body has the power to remove calcium and phosphorus from the bones in order to use them for other body functions, such as reproduction and milk production, and their continued absence will result in soft, porous, weak bones that are easily fractured.

Calcium is present in alfalfa, clover, and other legume roughages in sufficient amounts to meet the needs of animals if at least one-half of the roughage fed is leguminous. Pastures and grass hays that are grown on soils rich in calcium are also rather satisfactory sources of calcium. Animal by-products such as tankage, skim milk, and fish meal are among our best sources of this mineral. Other concentrates, including the cereal grains and their by-products, cotton seed products, and similar protein-rich feeds of plant origin are all low in calcium. Corn and sorghum stovers, fodders and silages, as well as grass hays and pastures grown on soils that are low in calcium also are likely to be poor sources of this mineral.

Sources of phosphorus

Phosphorus is not nearly as abundantly present in the roughages as is calcium. The legume hays are usually only fair sources of phosphorus, and the grass hays may be fair

to poor sources, depending upon the phosphorus content of the soil. The cereal grains at best are only fair sources of phosphorus; however, some of their by-products, such as wheat bran and wheat shorts, are among our best sources of this mineral substance.

Cottonseed meal and other protein-rich feeds (soybean oil meal, linseed meal, etc.), with the exception of corn by-products, are nearly equal to wheat bran as sources of phosphorus. The animal by-products, in addition to being excellent sources of calcium, as has already been mentioned, are excellent sources of phosphorus.

In addition to the need of calcium and phosphorus by animals, these two minerals—because of their close relationship in the body—are needed in a more or less definite ratio. In other words, a large excess of calcium may lead to the inability of the animal body to utilize phosphorus efficiently. This may make it appear that phosphorus is lacking even though there is the correct amount of this mineral in the diet. In a similar way, a large excess of phosphorus may bring about the improper utilization of calcium that may be present in the ration in the right amount. For the best results in practical feeding the calcium-phosphorus ratio of the diet should be maintained between 2 : 1 and 1 : 2.

Use least expensive

If calcium is lacking from a ration that is adequate in phosphorus the calcium may be supplied by supplementing ground limestone, ground marl or pulverized oyster shell. These substances are about equally good as sources of calcium, the one to use being the one that costs least.

When dairy cows are being fed no legume hay their calcium needs can be met by including 1 per cent of any one of these supplements in the concentrate mixture. If hogs are not receiving feeds high in calcium the feeder should include 1 per cent of calcium supplement in their mixture. Beef calves being fattened on a ration with little or no legume hay will give somewhat larger gains if one-tenth of ground limestone or oyster shell per head is fed daily. This may be mixed with the cottonseed meal or other ground feed. Under the same circumstances—that is, when calcium is lacking but phosphorus is plentiful in the feed—beef breeding cattle, all range cattle, horses, sheep, and goats may be given a lick of two parts ground limestone or oyster shell and one part salt in addition to the lick of plain salt, or one part ground limestone or oyster shell and one part salt with no additional salt.

When adequate calcium is present in the feeds, but phosphorus is lacking, dairy cows and hogs should receive 1 per cent of steamed bone-meal, spent bone black, or rock phosphate (if this latter is guaranteed fluorine free) in their grain mixture. For other classes of stock a mixture of two parts steamed bone-meal or any other phosphorus supplement with one part salt will be satisfactory when a separate plain salt lick is supplied in addition, or a mixture of one part steamed bone-meal and one part salt when no additional salt is provided.

When the feeds used are lacking in both calcium and phosphorus a mixture of bone-meal and salt will supply both of these minerals. Most authorities on livestock feeding, however, advocate a mixture of two parts ground limestone, two parts steamed bone-meal, and one part salt when a separate salt lick is supplied, and a mixture of one part ground limestone, one part steamed bone-meal, and two parts salt when no salt is fed in addition. Adding the ground limestone to steamed bone-meal and salt will lower the cost per 100 lb. of mixture.

Many stockmen are in favour of adding about 5 per cent of cottonseed meal to their mineral licks in order to increase the palatability and thereby insure greater consumption of the needed minerals.

At this point it may be well to mention that vitamin D is necessary for the proper utilization of calcium and phosphorus. This is especially true for young animals. As this is not a discussion on vitamins, let us say simply that stockmen need not worry about this vitamin if their animals have plenty of good quality sun-cured hay—preferably legume—or are exposed to plenty of sunshine. In most sections of the United States if animals are not kept in barns they will obtain sufficient

vitamin D in their bodies to meet all their needs. Those animals that are confined in barns during the day, or otherwise get little or no sunshine, should have plenty of sun-cured hay.

Tall tales on sulphur

Among the minerals often fed to livestock is sulphur. Its use in the ration seems to be enshrouded with a legend that it will save the animals from tick and louse infestation. It is true that sulphur is needed in the diet, but only as a component part of feed protein and not as the mineral sulphur. Experimental work has failed to show any connection between sulphur in the feed and freedom from ticks or lice, nor has it shown any reason why sulphur should be added to the salt lick.

One or two other minerals needed by animals have been found deficient in a few isolated areas of the world. They, however, are generally found in adequate amounts in the majority of soils and feeds and are, therefore, of no immediate concern to the great majority of livestock growers and feeders of the United States.

One mineral that needs mention, not because it may be lacking but because of its poisonous effect when present, even in traces, is fluorine. Fluorine may be found in some limestones and some phosphatic rocks in sufficient amounts to cause much trouble in farm animals through its softening effect upon the teeth. For this reason any rock phosphate that is to be fed to animals should be guaranteed fluorine free. For the same reason it is not wise to use superphosphate as a mineral supplement for animals, although as fertilizers these phosphates are perfectly safe and will not produce ill effects in animals to which the crops, grown on such fertilized fields, are fed.

Claims are often made that various minerals are essential for the prevention of many ills and ailments of farm animals. The wise stockman will do well to communicate with his state experiment station before trying out any of these high-powered minerals.

A safe and sound suggestion is to see that your animals have adequate salt, calcium, and phosphorus. If any of these substances is lacking in the feeds use the appropriate mineral mixture already suggested. Other than for these three minerals, use no mineral supplements unless you are advised to do so by your state experiment station or by another competent authority.—*Dr V. H. Melass, Instructor in Animal Husbandry, Texas A. & M. College in* The Cattleman, *Fort Worth, Texas.*

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HIGH QUALITY APPLES

THINNING, or the removal of a portion of the fruit crop before maturity, is an orchard practice which has been considered profitable and recommended by authorities on fruit growing for several centuries. The benefits to be derived from thinning apples are many but fall into two main categories: (1) the improvement of the crop, and (2) the conservation of the tree. The main advantage, however, is the improvement of the size and quality of the crop harvested. With the large sizes of extra fancy grade in increasing demand and commanding premium prices, thinning is undoubtedly now more profitable than ever before in the history of the fruit industry in Canada, says D. S. Blair, Division of Horticulture, Central Experimental Farm, Ottawa.

Research has shown that under most conditions the size of the fruit may be increased and a better quality product obtained by an artificial thinning. It will not only go far in eliminating under-size apples, but, by careful thinning, many of the defective apples resulting from insects, diseases, hail and rubbing are eliminated, which greatly reduces the cost of harvesting, packing and marketing. Distributing the fruit uniformly over the tree will result in a more uniform product which is of particular importance where box packing is done. Thinning prevents, to a very large degree, the danger of serious breakage of limbs and the splitting of crotches due to over-cropping and lessens the cost of propping. One of the most important considerations, as far as tree conservation is concerned, is the tendency of thinning to make the tree more regular in bearing habit. Thinning, provided it is carried out reasonably early in the

season, together with intelligent pruning, manuring, and soil management, will bring about more even annual cropping of all except a few varieties which are inherent biennial bearers.

The distance apart to leave the fruit will depend very largely on the variety and general condition of the orchard. Research work has shown that leaf area is of major importance in determining fruit size and with an increase in the number of leaves per fruit the size increases. Thinning thus affords a means of adjusting the crop to the leaf area in order to obtain the desired size of fruit. This fact should always be kept in mind. In the case of McIntosh the trees have a large leaf area per unit of branch and will develop the required large sizes equally as well when spaced four inches apart, as compared with Wealthy when spaced six inches apart. Varieties with a small leaf area per unit of branch, such as Winesap, may have to be thinned as far as nine inches apart. In general, however, only one apple should be left per spur or bud and the individual apples on a branch spaced to six inches apart. All blemished and imperfect fruits should first be removed. In spacing, the fruits that are to remain should be left on the upper side of the limb as far as possible where they will be exposed to sunlight.

There are various methods employed to remove the apples from the tree. The most efficient is to hold the stem of the apple between the thumb and first finger and with the pressure or force of the remaining fingers separate the apple from the stem. In this way the apple is removed without disturbing the fruit spur and other apples attached to it. Light shears are sometimes used and are advantageous for late thinning when it is difficult to separate the apples by hand. It should be kept in mind that shears slow up the work.—*Press Note, Dominion Department of Agriculture, Canada.*

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MILK RECORDING

'MILK recording (not necessarily through an official milk recording society) is being advocated very strongly as an aid to dairy farming in wartime,' states *The Home Farmer* (the official journal of the Milk Marketing Board) in its November issue, and continues: 'The known performance of every cow in the herd is an invaluable aid to production at a time when every pint of milk counts, when rations cannot be afforded to wasters and when pasturage is precious.

'Milk recording, especially when it is unofficial, is not the tedious business many farmers suppose it to be. It is, of course, another encroachment on man or woman power, but there are such obvious financial advantages from maintaining the milk supply without wasters in the herd that recording is a sound commercial proposition. The farmer who claims to "know" his bad doers without records has had his "intuition" upset time after time. And in any case, he cannot put his finger on the leakages of feeding-stuffs and build up a herd that is *small* enough to give big yields.

To maintain the milk supply—and it must be maintained if dairy farmers are to uphold their reputation—every cow must pull her weight. "Fancy" yields are harmful to wartime herd management; low yields mean a dangerous gap in the food defence. Recording alone can take wartime efficiency to the cowshed.'—*The Veterinary Record*, 29 November 1941.

New Books and Reviews

An Agricultural Testament

By Sir Albert Howard (Oxford University Press, 1940, pp. 253, 15*s*.)

THE title of the book is so alluring that anyone interested in agriculture will be tempted to add this book to his library. As a literary work also, it is fascinating reading. On Biblical analogy one, however, expects ten commandments; but Sir Albert has only one commandment, viz. compost—nay compost prepared by his Indore Method only. There should not be the slightest contamination of artificials even as starter for decomposition as recommended by the Adco process. According to the author, one must not touch artificials even with a pitchfork if soil fertility is to be maintained. This 'back to nature' protest from a westerner is really refreshing.

As a counterblast to Liebig's theory of mineral nutrition, this book might have rendered valuable service at the time. Liebig belittled the existing theory that the value of bulky manures lay in their organic matter and expounded a new one that it lay in their ash constituents. This marked the beginning of the mineral theory of nutrition and as a result, a school of scientists arose which asserted that artificial manures were not only more remunerative than dung but were the only way of keeping up soil fertility and the practice of adding bulky manures was not an essential feature of agriculture. The advent of bacteriology and the development of soil physics, however, falsified this view by showing that soil fertility is not a simple chemical problem as propounded by the mineral school of thought. Research has thus definitely established the importance of organic matter in crop production and the need for the maintenance of its supply is now acknowledged in any modern method of husbandry, while in forests the removal of leaves and other decomposable matter is recognized as undesirable. Artificials are not condemned, but it has been recognized that the full benefit of artificials can be realized only when the supply of humus has been adequately provided. There is thus a great field for artificials when this condition is satisfied.

The book would have been thus passed over as one more addition to the existing literature on humus if the author had not downright condemned artificials, making at the same time extravagant claims for composts (prepared by his method only), which could not be substantiated by existing facts. Some of the generalizations made by him are also dangerous as they are partly true. Taking only one instance, the author maintains that a plant grown in soil treated with compost without any artificial manuring will be practically free from pests and diseases and therefore the present organization of entomological and mycological research is a gigantic and expensive failure. It is quite true that depredations of certain insects can be greatly reduced by securing a vigorous plant. There are, however, a great number of insects which are observed to thrive in proportion to the vigour of the host plant. Pyrilla, white fly and rice grasshopper are some of the common instances. As regards artificials, Russell, in his recent review of the famous Broadbalk wheat experiment at the Rothamsted Experimental Station (Technical Communication No. 40), found no special effect of artificial fertilizers on the incidence of insect attack even after 88 years of continuous manuring. It seems not to have been realized by Sir Albert that climate exerts a great influence on the spread of insect pests and diseases and it would be thus risky to generalize from a few casual observations. At the same time, it cannot be denied that in the case of artificial fertilizers there is a risk of increased susceptibility to diseases owing to unbalanced nutrition. For instance, a heavy dose of sulphate of ammonia or nitrate of soda will lead to the development of crinkled soft sappy leaves liable to insect and fungus pests in case of potassic deficiency. The use of artificials alone may also create

deficiency of some of the minor elements as boron, manganese, etc., which are known to have stimulative and prophylactic effects. A good scientific background is therefore essential for the proper use of artificial fertilizers in a balanced nutrition and all the ills attributed to them by the author are due to his lack of appreciation of this fact.

The book bristles with similar statements which it would not be possible to place in proper perspective in a short review. As a rule, these statements are based on general observations and, time and again, the author has made it quite clear that he does not believe in quantitative data as obtained at experimental stations and has pooh-poohed the use of statistics in the interpretation of the same. Further, although the author has used four chapters, occupying about one-third of the book, in discussing the development of the Indore process, there is no mention, throughout, of the economics of the method. Like statistics, economics are also anathema to him. These shortcomings greatly detract from the value of the book as a scientific monograph.

This obsession of the author about the celestial qualities of compost is also the keynote of his condemnation of the organization of present-day agricultural research. The problem is not, however, so simple that all agricultural ills can be cured by soil aeration and by regular supplies of freshly prepared humus from animal and vegetable wastes. These remedies of the author cannot also supply the rising needs of the human as well as of industrial hunger and in this connection there should be no denying the fact that artificial fertilizers have a future.

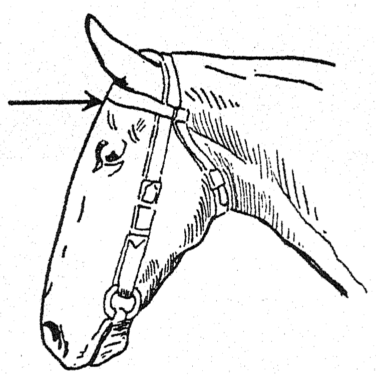
Agriculture embraces many associated sciences, and considering the rapid progress which these sciences have made during the last decade in any organization of agricultural research it is but rational to imagine that one researcher cannot tackle the problem in all its aspects and that team work is the only solution. This, however, necessitates the fragmentation of the problem, and the establishment of research institutes—only on the basis of the particular science—militates against that high standard of professional cooperation which is required for successful team work. The tendency of the workers in these institutes would be to confine themselves to some aspects of their specialized field. To take only one instance, the breeding institutes confine themselves to breeding either high-yielding or disease-resistant varieties. When such a variety is released for general cultivation, nothing is known of its nutrition, and this is the reason why deterioration of varieties after a few years' trial is reported so often. In fact, hardly a single breeding institute possesses a physiologist to carry out these important studies on which the future of the variety depends. The author is, therefore, as usual, partly right when he condemns the present tendency of excessive departmentalization and too much specialization in agricultural research.

Industry has created a new hunger of the machine for raw products. It is, therefore, no use closing our eyes to the fact that the fields will have to respond to the hungers of both the stomach and the machine. The author has, however, got no solution for this. Science connotes progress and the role of the real scientist is not to ask us to go back to nature or adopt a safe method when by following the same it would not be possible to satisfy both these hungers. Many experiments throughout the world have proved that humus is necessary for maintaining soil fertility and artificials are capable of giving record yields of great economic value. It is, therefore, felt that if instead of assuming the role of the Apostle of Humus by making extravagant claims for it and by condemning artificials, Sir Albert had attempted in this book to focus our attention on the possible method of bringing artificials into 'gear' with humus, he would have certainly done a great service to the agricultural world and would have justified the title of the book.—(R. D. R.)

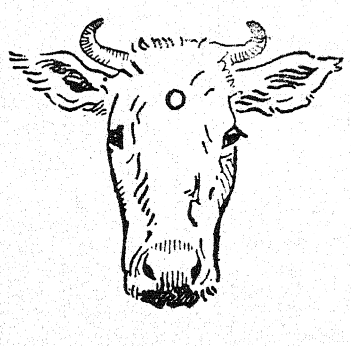
From All Quarters

A. R. P. FOR ANIMALS

DURING an air raid it may become necessary to destroy animals such as horses, cattle, sheep, goats, etc. which have been seriously injured or which are dangerous or at large or out of control on account of enemy action. To perform this task humanely it is necessary that the humane cattle killer or an ordinary pistol should be directed towards the brain at the right spot in order to cause instantaneous death. For this purpose the following illustrations along with necessary instructions will be found useful. Humane destruction of dogs and other small animals can be done by a veterinary graduate using hydrocyanic acid which is usually available at all veterinary hospitals.



Horses.—In despatching horses, errors are mainly due to the operator aiming too low. Place the muzzle of the pistol against the forehead skin immediately below the roots of the forelock.



Cattle.—Cattle of all classes should be neck-roped or haltered. Draw imaginary lines from the base of each horn to the eye on the opposite side and aim at the spot where these lines cross.

Sheep.—Aim at the centre line of the forehead between the levels of the ears and eyes. Another position is midway between the ears, aiming straight down towards the gullet.

Horned sheep.—Place the muzzle in the centre line immediately behind the ridge which runs between the horns and aim downwards towards the gullet.

Goats.—As for sheep.

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ZEBU CATTLE ABROAD

IN a paper read by R. B. Kelley at the Seventh International Genetical Congress, Edinburgh, August, 1939,* it is stated that in the Philippine Islands, British-bred beef cattle have failed to withstand the climate and a cross of Hereford with native cattle and Zebus† is being established. In Trinidad, for milk production, reliance is being transferred from European stock to crosses between these and Zebu cattle. In the southern States of the U. S. A. hybridization of Zebus and British cattle is carried out very extensively and is giving better returns than those derived from British cattle.

* *The Empire Journal of Experimental Agriculture,* Vol. IX, No. 35, July 1941.

† Zebu is a general term which covers the humped cattle of India.

More direct evidence from the Zebu hybridization experiments of the Council for Scientific and Industrial Research, Australia, has shown that the Zebus and their crosses do remarkably well in tropical Australia. Kelley reports that the imported (Zebu) animals, 19 in all, have remained in excellent condition throughout five years of station life in the Australian tropics. Five pure-bred males and five pure-bred females have been reared. Matings resulting in four males and three females have been made between the imported three-eighths Santa Gertrudis cross-bred bull and some of the imported females. Hybrid progeny by the imported bulls greatly outnumber all other kinds. Their approximate total is 1,193, comprising 26 threequarter-breds, 630 half-breds, and 548 quarter-breds. Of these, 333 are bulls of various ages, 261 are steers, while the remaining 599 are females. The pure-breds are repellant to cattle ticks, have a high resistance to infection with *Piroplasma bigemina*, and are more tolerant of heat than British-bred animals. It has also been observed that they transmit these peculiarities to their cross-bred progeny. Further, it is apparent that the cross-bred's degree of characterization exists in direct proportion to the percentage of Zebu 'blood'. The imported Zebus and their progeny have been exposed to extreme drought conditions. Upon one such occasion the northern divisions of Queensland, in which these observations are being carried out, lost 63 per cent of their British-bred cattle. There were no losses among the experimental groups although no supplementary feeding was practised.

These observations indicate that, in many respects, Zebu hybrids would be excellent animals with which to stock northern holdings. However, with regard to the timidity and liveliness of these animals, caution is necessary before such a recommendation could be made. The observation must proceed until it is shown what percentage of Zebu blood combines the advantages of the tropical type with the docility of the British breeds.

THARPARKAR RECORD

SURA at the Birlapur Dairy Farm has beaten the all-India record for the daily milk yield of her breed. This Tharparkar cow gave $49\frac{1}{2}$ lb. on 10 February 1942, whereas the previous record for this breed in India is said to be 48 lb. Sura calved on 16 August 1941 and has given 7,020 lb. milk in 187 days and is still giving 47 lb. per day. She began with 42 lb. on 1 January and ended the month with 43 lb. On 1 February she gave 46 lb. and the record of $49\frac{1}{2}$ lb. was reached on the 10th.

This cow, formerly named Rafekan No. 88, was bred by the Imperial Dairy Expert at Karnal and was bought by the Birlapur Dairy Farm a few years ago.—CHAJJU RAM BHUTT, Superintendent, Birla Dairy Farm, Birlapur, 24-Parganas.

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THE HIDES AND SKINS INDUSTRY AND THE WAR

IN previous editorials in this magazine, in which an attempt has been made to show what contribution the different livestock industries of India can make towards her war effort, we have dealt with what might be called living products. It is now necessary to turn our attention to a dead product, and although it is certain that such a product will never have the same interest to the livestock breeder as a live product, for it can be produced only once in an animal's lifetime, yet hides and skins, as the precursor of leather, rank very high in the list of world commodities. And India is very much interested in this commodity, of which she is one of the largest producers.

The estimated annual production of hides in India is 25·7 million pieces and of skins 44·6 millions. Previous to the war, India possessed a large export trade in both products, the figures for 1938-39 being Rs. 330 lakhs worth of hides and Rs. 527 lakhs worth of skins. The chief importing countries were Germany for raw hides, Great Britain for semi-tanned hides and skins and the U. S. A. for raw skins. For reasons connected with the war, this trade, with the exception of the skins trade with America, has been temporarily lost, but the gap has been more than filled by the demand of the Defence Services for leather for different purposes. Naturally, good quality leather is required, and unfortunately a large amount of the raw material is dealt with in a most unsatisfactory manner in India; and unless action can be taken quickly to effect the necessary improvements, this is likely to have serious repercussions.

The chief defects, regarding which complaints have been most common in the past, have been connected with flaying, curing and pests. Any hide, however good it may have been originally, may be ruined by bad flaying, and the Imperial Council of Agricultural Research has recognized the great necessity for improvement in this initial step in hide production by advocating the appointment of peripatetic flaying parties to tour the villages and the employment of flaying supervisors in slaughterhouses, with a view to inducing the actual flayers to take more interest in their craft.

The curing of the raw hide or skin is also a most important link in the chain and elsewhere in this issue is given a description of a new method of dry-framing hides, which, if introduced on a large scale in India, would raise the quality of the primary product enormously.

Lastly, in connection with pests such as warbles and ticks, the Imperial Council of Agricultural Research, by providing funds to the Imperial Veterinary Research Institute for the investigation of the life-history of the different parasites involved and the study of the best methods of prevention, has shown its active interest in this subject; and it is satisfactory to be able to state that the prevention of both these pests is now being undertaken in selected areas on a field scale.

While the prevention of damage by pests must to a large extent remain the responsibility of provincial and state Departments, the improvement of flaying and curing can best be carried out through more non-official agencies.

In the villages rural development boards and, where they exist, such institutions as dead animal product factories, which depend on the villages for their supplies, can do much to improve matters. In the more urban areas municipal and notified area committees have a large responsibility in providing the best possible facilities at their slaughterhouses, where the most promising raw material is to be found.

In fact, everyone interested in this trade and each one of us who keeps large animals can do something to help, for every hide or skin that is properly removed and cured makes a small but efficient contribution to the war effort.

SCIENCE IN THE U. S. S. R.

THE chief differences between scientific laboratories in the U. S. S. R. and our own are in the planning of research, the youthfulness of the staff, which creates a lively atmosphere, and in the higher status of mechanics and laboratory assistants. There are organized political discussions, designed to explain to the scientists the importance of their work for the development of the country, and so encourage them to fresh effort and discovery. The general lines of research for the laboratory are laid down by planning committees. These consist largely of leading scientists from various parts of the country who meet periodically in Moscow. In this way plans are made for all the research in physics, chemistry and biology; overlapping is avoided and the greatest aid is given to the industries using these sciences as well as to the advance of pure knowledge.

When planning is badly done it may destroy initiative, but on the whole, when it is supported with plenty of money, it is more fertile than unorganized individual effort. One must remember that the plans for research are in the main drafted by the scientists themselves. They set their own problems for themselves. They are not just told to attempt to discover something by a bureaucrat who knows nothing about it. The planning of research is carried out by the Academy of Sciences: this is its main function.—J. G. Crowther in *The Listener*, 4 September 1941.

Original Articles

ESTATE FARMING IN INDIA

V.—THE INDIAN MILDURA FRUIT FARMS, LTD.

By 'Kissan'

THE Indian Mildura Fruit Farms, Ltd., Reñala Khurd, Montgomery district, Punjab, was established in 1920 when the late Mr F. J. Mitchell was given a grant by the Punjab Government of 722 acres of land in the Lower Bari Doab Canal Colony for the purpose of improving fruit-growing in the province and to encourage commercial fruit-growing in that newly irrigated area by importing proved varieties of fruit trees and propagating from these.

Enemy of viticulture

It was the first intention of Mr Mitchell to plant a large area with vines for the production of grapes for the dried fruit market. He definitely proved that it was possible to grow many varieties of vines and produce satisfactory crops of grapes in the Punjab plains and under irrigated conditions similar to irrigated areas in Australia on the Murray River (e.g. Mildura). It was for this reason Mr Mitchell sent his manager to Australia to study viticulture and the drying of grapes and on his return the manager brought with him all varieties of vines he considered would prove equally successful here. This project was eventually given up as being too ambitious, with too many unforeseen difficulties presenting themselves. The white ant was the main enemy, and after spending a great deal of money on using poisons, gassing equipment and other known methods of destroying this pest, it was found that hoeing and other means of intensive hand cultivation was the only practical but not the most economical method of effectively destroying the pest. The white ant in this locality is the scavenging variety working near the surface in very small narrow runs and not like other varieties which have wider runs, are easily gassed, and are not so widely distributed in small colonies. Other pests were birds, mostly parakeets, and numerous species of ants which were ever ready to attack the fruit on drying trays. It is possible to produce a first-class dried Sultana, Muscatel and Zante Currant in the Punjab. Varieties of vines grown were Muscat of Alexandria, Sultana, Zante Currant, Thomson's Seedless, Black Hamburg, Red Hamburg, Gros Colman, Waltham Cross, Doradilla and other varieties with a view to the possibilities of developing the wine industry as a secondary development. Only varieties of grapes which ripened before the arrival of the monsoon really proved successful, and a most interesting collection of these are now in a demonstration plot at the Lyallpur Agricultural College where anybody interested in viticulture can see them.

Import of citrus plants

Citrus cultivation did not present so many difficulties. The main difficulty was to produce satisfactory nursery plants to keep pace with the rapid planting programme demanded by the Government. It would have saved much time and money if we had been given the opportunity of propagating from trees imported by us of known parentage and after they had proved themselves capable of producing fruit of quality and in satisfactory quantity in these climatic conditions. The following varieties of citrus have been imported by us from Australia, Florida, South Africa, Palestine, and Japan:

Australia: Washington navel (have not given satisfaction), Valencia late oranges.

Florida: Marsh seedless and Duncan's grapefruit.

South Africa: Eureka lemons, Duncan grapefruit, and Valencia late oranges.

Palestine: Clementine, Satsuma, King,

Temple, Tangebis, Nagami, Dancy, and other varieties of oranges; also Eustis limequats and Meiwa kumquats.

Japan: Trifoliate orange.

Had Alexander the Great and other rulers in India taken as much interest in citrus-growing as did those Mediterranean countries where seeds brought by Arab traders from India and the East were cultivated, there would probably have been no need for us to import citrus plants into India where very little history of this valuable fruit has been recorded. As gardening and fruit-growing were, and even now are, considered only possible for the very (idle) rich, it is likely that the citrus fruit in India has a longer history than is now realized by the various Agricultural Departments. A search for more history may reveal some interesting information. We can claim that we have almost a complete collection of all varieties of the citrus family. Not given time to produce our own nursery plants, we were forced to buy wherever we could at high prices from nurserymen, who before the appointment of the present Fruit Specialist to the Punjab Government, were uncontrolled and extremely unreliable. We have been obliged to cut our worthless trees to the value of nearly a lakh of rupees and hope that others, reading this, will not suffer likewise.

Teaching of experience

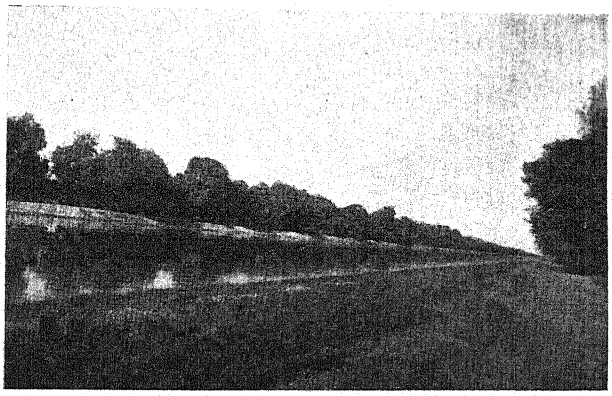
Before planting an orchard it is strongly advised that the prospective fruit-grower should first select land which is most suitable for the class of fruit to be grown. Any money spent on a thorough survey by an expert analytical soil chemist will be money well spent. At Renala Khurd we would have saved thousands of rupees if we had avoided *kalelar* patches that have since appeared and other undesirable areas. Uniformity of trees is most essential. If citrus trees are properly shaped in the nursery, by judicious early pruning, they should not require further pruning for four years or more. Suckers should always be looked for in spring and early monsoon and should be removed when very small. The value of a citrus grove is greatly enhanced if different varieties, early and late, are planted in separate blocks to facilitate protection and harvesting. We have a very good demonstration of good planting at Kissan station. Plant orange trees not less than 22 ft. and lemons, limes and grapefruit not less than 25 ft. apart. Obtain full information and benefit from others' experience before planting. Do not experiment. No farmer can afford this expensive hobby—leave this important work to the Agricultural Department. Stray animals, especially goats, will ruin young trees, spoil their shape and cause hundreds of rupees' worth of damage in a few minutes. A buffalo bull, in a few minutes, by rubbing his forehead, will destroy almost completely several four-year-old orange trees producing their first crop. Therefore keep cattle away from fruit trees, but encourage poultry. Fruit-growing cannot be carried out as ordinary zemindari on the tenant system: strict supervision must be kept over labour and the only way to train supervisors is for the owner to train them himself.

Value of seedling stocks

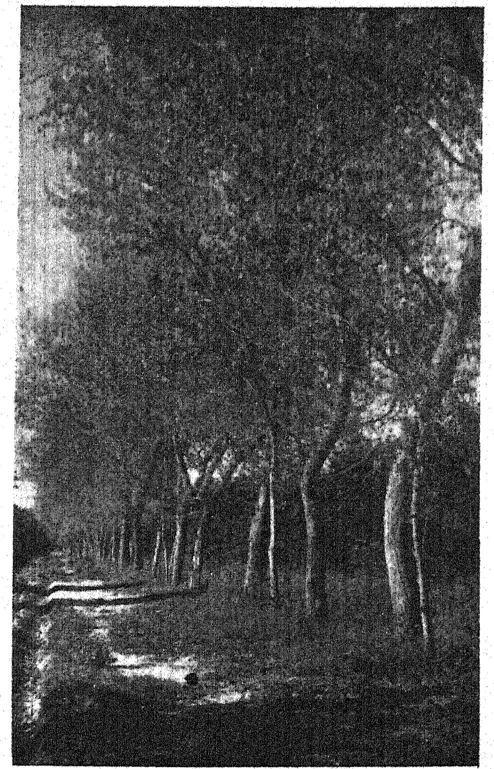
During his visit to South Africa in 1927-28 the writer was very much impressed with a seedling orange orchard owned by Major Thamson outside Pretoria and on his return planted a seedling orchard of Nagpuri oranges. This orchard has proved of great interest and may yet help to prove that Nagpuri or other Mandarin oranges are best grown from seed of selected seedling trees. The complaint of die-back, common to this variety of citrus, can possibly be overcome if a thorough and continuous research over a long period can be carried out on the propagation and growing of selected seedling stocks. Among these seedling trees we have, growing by mistake, Malta type orange trees which are also of interest. In the photograph it will be noticed that these seedling trees grow much higher than budded trees.

Other fruits grown by us are figs, plums, peaches, dates, loquats, mangoes, *phalsas* and *jamans*. Figs and plums we have canned with very satisfactory results. We have a few peach trees bearing fruit of very good quality and quantity and in due course we have to increase the number of these trees. We think that research on suitable peach stocks

Indian Manager's quarter

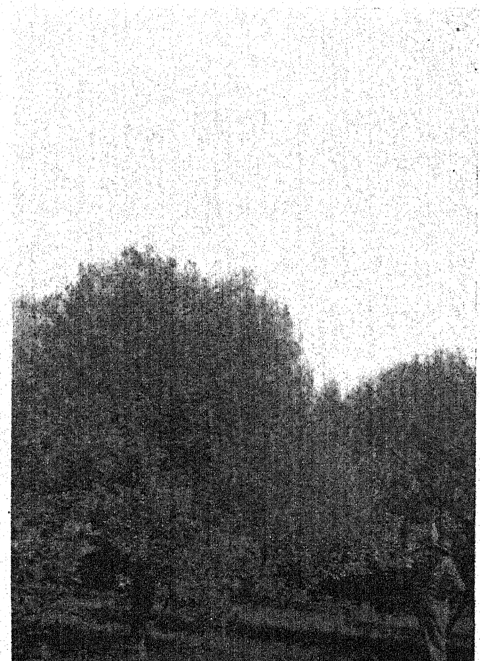


The Lower Bari Doab Canal at Renala Khurd 30 miles from the headworks

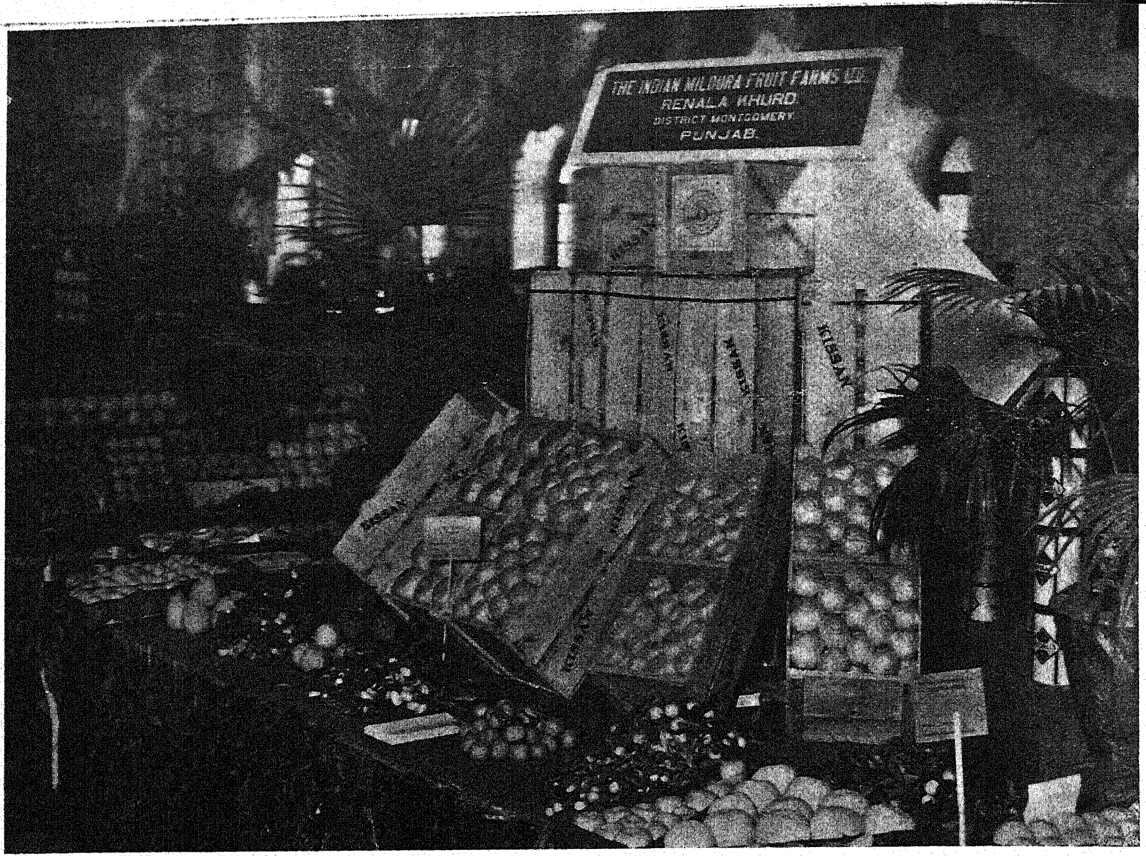


A windbreak grown round each 25 acres

Seedling Nagpuri tree



Budded Nagpuri tree



Mildura Fruit Farm exhibits at the Punjab Fruit Show

Cattle eating orange and other citrus skins

and scions for each locality in the province, such as has been carried out at the Agricultural Station at East Malling near London on apple stocks and scions for every locality and country of the United Kingdom, would show peach-growing to be a remunerative branch of horticulture in the Punjab and elsewhere in semi-tropical climates of India.

We are grateful to the Entomologist to the Punjab Government for his valuable advice in combating the fig-borer and other insect pests.

Attractive packing

In order to maintain satisfactory returns for the fruit grown in an area of over 500 acres we considered it essential to try and build up a direct trade in fresh fruit and so started selecting, grading, and offering our citrus fruit to the public in attractive packing. In this we have found good results, but at the moment of writing, owing to the war demand for paper, wood, nails and steel strapping, it appears that we may have to depart from our usual methods until after the war. Without satisfactory marketing arrangements, the full value of any produce cannot be obtained. Fruit being a perishable articles, this is all the more important. The Lahore fruit-market, before the Punjab Fruit-Growers' Cooperative Board interested themselves in this most important centre, was the worst kept manure heap in the province. On a wet day it was unapproachable on account of mud and stench. All markets should be controlled by municipalities who can derive much revenue from increased sales on fruit and at the same time benefit the public by preventing food contamination. The development of public opinion in urban areas will no doubt bring about the much more necessary urban than rural reconstruction in India.

Fruit products

Having dealt with first-grade fruit for the market, our attention was directed to the disposal of fruit which was more suitable for the manufacture of fruit products. We are now producing in our factory, situated actually in the citrus groves, orange, lemon, grapefruit squashes with and without the addition of barley, lime juice cordial (large quantities of which are now being supplied to the Army) marmalade, tinned grapefruit, figs in syrup, plums, etc. all marketed throughout India and adjacent countries under the 'Kissan' trade mark. This successful venture has now developed into a business with a much larger capital expenditure and turnover than first anticipated. Our new canning factory, we hope, will be in production by May 1942, when we hope to be able to extend our assistance to the Supply Department. In order to avoid any waste we are investigating the possibilities of turning any excess of skin and pulp, which at the present is used for manure, into a cattle feed. Our cattle keep in very good condition fed on fresh surplus skins and we hope to be able to produce a balanced feed at a price within the means of all cattle owners. The photograph shows our cattle feeding on skins after the juice has been extracted. We give a photograph also of one of the staff quarters and as horticulturists endeavour to encourage others to maintain happier surroundings. The reason why most agriculturists do not spend money on beautifying their homes is that there is little security of tenure in India which in many cases is the cause of inefficiency of agriculture.

Government assistance

Having developed the largest commercial fruit farm and probably the largest fruit preservation factory in India, we can now say that fruit farming is the most difficult branch of agriculture to take up and that the manufacture of its by-products is equally difficult. Unfortunately, our fruit preservation department has introduced an atmosphere foreign to the usual pleasure of Indian farming. The Factory Act and other regulations to satisfy a different class of labour are forced upon our rural life. Improvements can be and will be made in our fruit orchards and likewise in our factory. We have hundreds of visitors yearly and willingly give them assistance and show them round—provided the staff if available and sufficient notice is given.

We would express our appreciation of the Fruit section of the Agricultural Department of the Punjab for their valuable assistance and cooperation during the last 12 years in fruit-growing and the preservation of fruit.

PREPARATION OF 'FRAMED' HIDES IN INDIA AND JAVA

By D. N. Khurody
Senior Marketing Officer, Delhi

THE annual production of hides in India is estimated at 25·7 million pieces. Of these, about 50 per cent are merely dried in the sun without cleaning or stretching and constitute what are known as *suktis* in the trade. This is the poorest type of cure and generally all the dead or fallen hides are prepared in this manner. About 37 per cent are 'wet-salted', that is they are cured with salt but are only partially dried and they remain in a pliable condition. A further 8 per cent are 'dry-salted' and the remaining 5 per cent are dried in a stretched condition without any salt. These are called 'framed' or 'dry-framed' hides. Tanners usually prefer the 'wet-salted' hides, but if the 'framed' hides are prepared with proper care and attention, they may be considered equally good, if not better, as they are lighter in weight and a good deal of freight and handling charges are saved in their transport.

In the curing of hides considerable progress has been made in other countries and so far as the preparation of 'framed' hides is concerned, the name of Java needs special mention. The Java-cured hides are said to be the best 'framed' hides in the world and, before the present war, some of the tanners in this country imported them regularly mainly on account of their superb cure, which is conducive to the making of superior quality leather.

The object of this article is to give comparative descriptions of the methods adopted in India and Java for preparing the 'framed' hides with a view to improving the former for the advantage of Indian curers and tanners. For the sake of a better comparison, the method followed generally in India is described first.

Indian method

After the hides are received from the slaughterhouse, they are spread on the ground, which may or may not be paved. The tail, portions of the face and ears are cut away from the pelt (Plate 82, fig. 1), but in doing so, uniformity of pattern is not aimed at. Meat which may be adhering to the flesh surface of the hide is scraped off with a knife; but since the job is carried out while the hides are spread on the ground, it cannot be done very satisfactorily. With the same knife, holes are cut (generally not more than 40) near the edges of the hide towards the neck and forelegs and towards the hindquarters, for tying it on the frames (fig. 2). No holes are made on the sides of the belly. The attention of the reader is particularly drawn to this aspect of the system. The hides are next dipped in a cistern of water to remove adhering dirt, blood, etc. but not always. In any case, the arrangements for replacing the water are generally poor and, except for the first few hides which may come out of the washing tank slightly cleaner, the hides submerged later can hardly be said to receive any cleaning at all. The so-called washed hides are then taken to the place where they are to be stretched on frames. This is usually the yard attached to the hide godown. The frames are made up of thin bamboos, which are invariably not strong enough for the job. Sufficiently strong stays are not provided to prevent the bamboos from sagging. This is another serious defect to which the attention of the reader is drawn. Further, the frames are not always of the size of the hides and, anyhow, the hides are mounted on them. It is also observed that, instead of using smaller frames for calf-skins, two calf-skins may be tied together at the ends and mounted on a standard frame. Thin coir rope or strings made of *muni* is used for fastening. Two men generally perform the operation (fig. 3). The stretching is uneven and wrinkles are generally left unattended (fig. 4). After mounting the hide on the frame, the assemblage is placed in the sun in an inclined position (fig. 5). Next day, the frame is turned over so that the other side also

G. 1. The operator is seen here cutting away portions of the face and ears from the hide. (India)

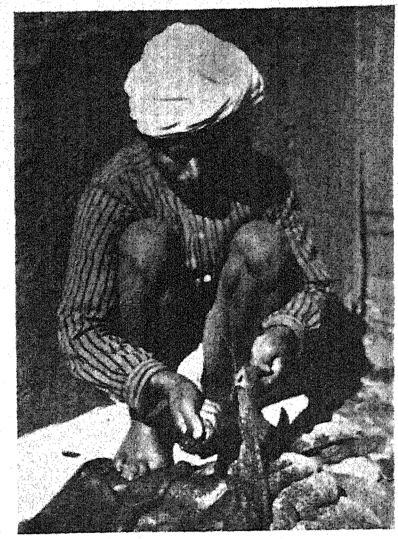


FIG. 2. Cutting holes on the edges of the hide for mounting it on the frame. (India)

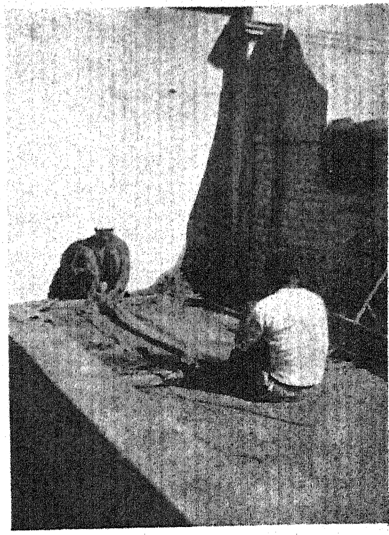


FIG. 3. The two men are seen here mounting the hide on the bamboo frame. (India)

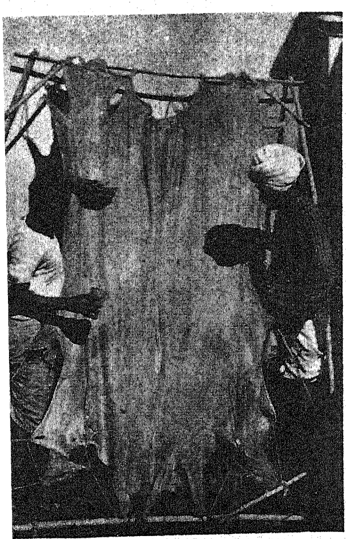


FIG. 4. This is how the hide is mounted on the frame. Note the uneven stretching and the presence of wrinkles all over the hide. (India)

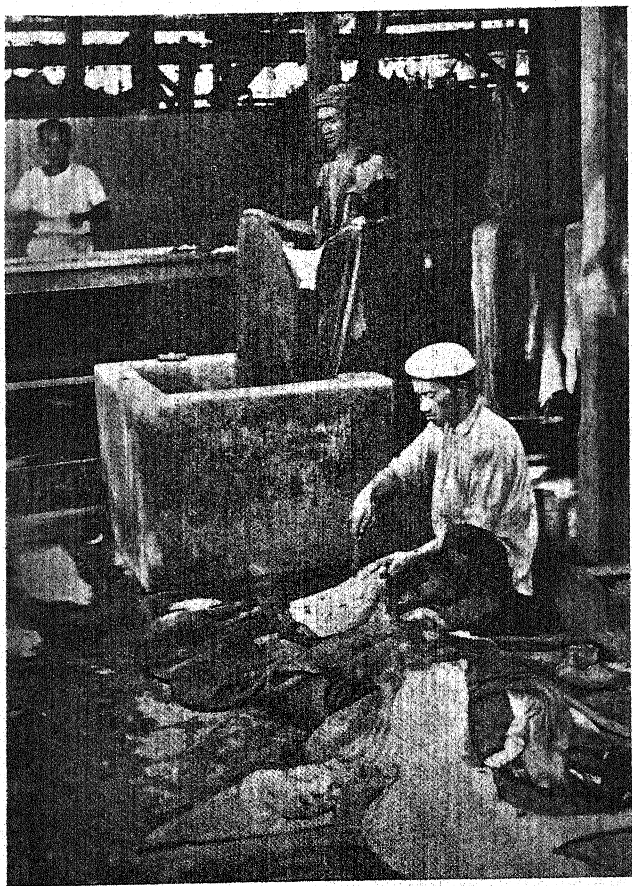
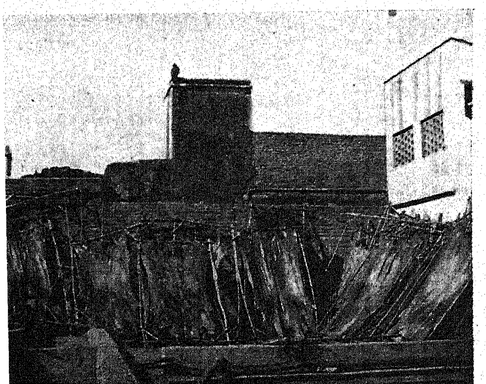


FIG. 6. Cleaning and washing of hides with a view to removing blood, dirt, etc. (Java)



5. Drying of 'framed' hides on the roof of a house. Note the pile of frames which results in uneven drying of the hides. (India)

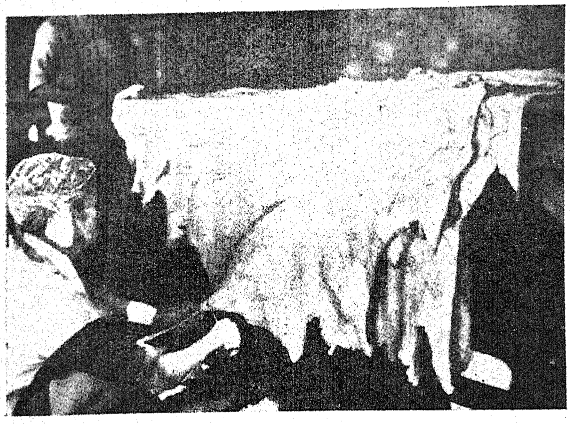


FIG. 7. Preliminary removal of flesh and fat and the cutting of holes at edges of the hide, for fixing it on the drying frame later. (Java)

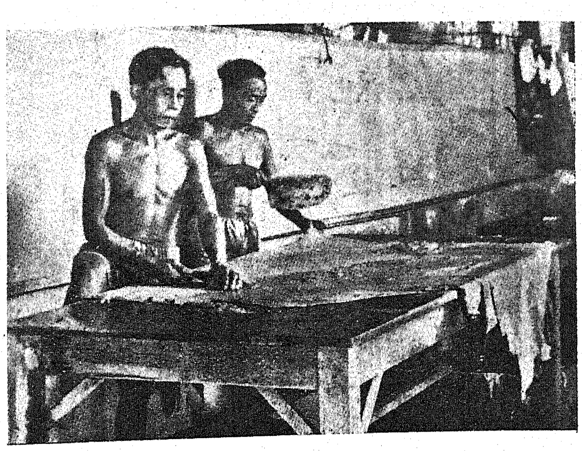


FIG. 8. Fleshing of hides is done on a table. A crescent-shaped knife is used for the purpose. (Java)

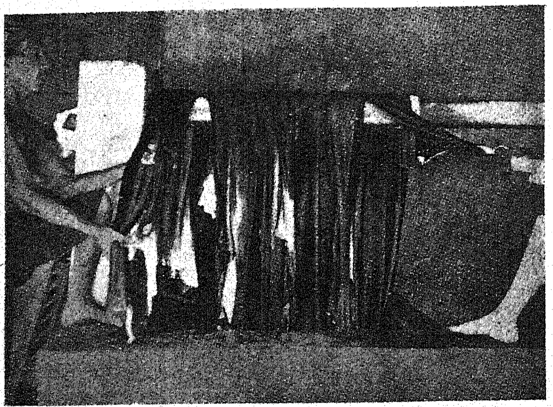


FIG. 9. Dipping of the fleshed hides in the arsenical solution, and their drainage. (Java)

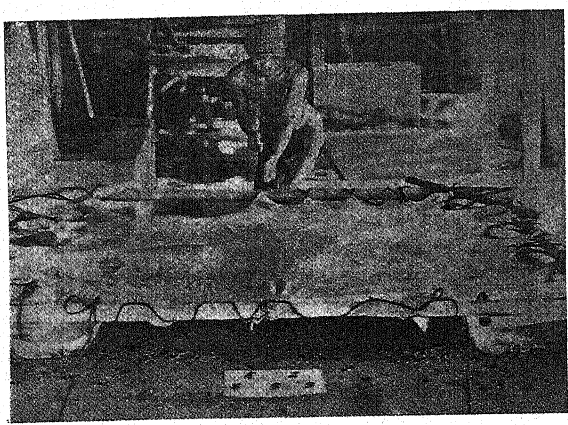


FIG. 10. Mounting and stretching of hides on stout frames by means of a string and S-shaped hooks. (Java)

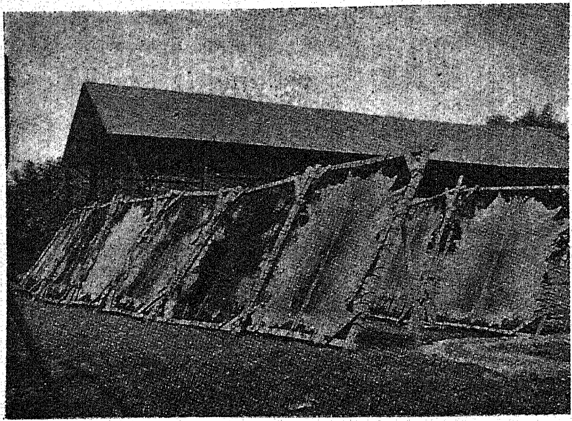


FIG. 11. Drying of 'framed' hides in the sun. Note the proper order in which the frames are arranged and their inclined position to avoid direct rays of the sun. (Java)

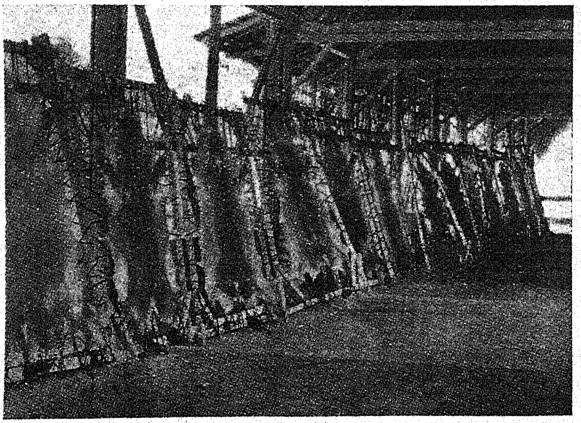


FIG. 12. The hides are finally dried in the shade in specially designed sheds. Note the orderly manner in which the frames are arranged. (Java)

receives the sun. During the night the frames remain outdoor in the yard. In winter, the hides are sufficiently dry in about four days' time, when they are removed from the frames, folded along the spine and heaped up for further drying. In summer, the drying is usually complete in two days but generally no hides are prepared in this season as they putrefy very rapidly.

The 'framed' hides prepared in the above manner in India are very hard and dry—so hard that sometimes they are termed 'flint-cured'. The fleshing and the cleaning, being done very imperfectly, have an adverse effect on the quality of the finished hide and consequently of leather manufactured from it. The pattern itself is not always good. Wrinkles are prominent throughout the hides and the stretching is uneven. In their present condition, the Indian 'framed' hides can be considered only slightly better than the '*suktis*', which, as described before, is the poorest type of cure practised in this country.

Javanese method

The Javanese method described below as well as the photographs illustrating the various stages of the cure, have been obtained from the Department of Economic Affairs (Industries Section), Batavia, through the courtesy of the Royal Netherlands Consul-General in Calcutta.

'In order to remove all the traces of blood and adhering dirt, freshly slaughtered green hides are washed thoroughly in clean water soon after flaying. The washing prevents the impregnation of blood and dirt into the hide substance, which otherwise diminishes the efficacy of curing (fig. 6). In order to drain off the water, the washed hides are hung for a short while on a horizontal pole. Thereafter, notches are made *all round* the hides, about 8 in. apart and at about 1 in. from the edge. Approximately 100 to 120 notches are made on each hide, depending upon its size. The distance between the notches may even be shorter in the case of hides of irregular shape. When the holes are being cut, a piece of wood is held under the hide. This prevents the holes from being cut too wide and, at the same time, gives uniformity in their size (Plate 83, fig. 7).

'The third stage is that of fleshing. This is done by spreading the hide over a large strong table and by removing the superfluous flesh, fat and tissues, with a sharp crescent-shaped fleshing knife (fig. 8). The operation is performed with great skill and care, so that a smooth surface is obtained without injuring or removing any of the hide substance. Now the hides are ready for putting on the frames, but before this is done, they are immersed for five to ten minutes in a preservative solution consisting of 1 part of commercial hide poison (containing 50 to 60 per cent arsenic) with about 90 parts of water. After poisoning, the hides are hung for some time for draining (fig. 9). When the arsenic solution becomes dirty, it is replenished with a freshly made one, and the tank is properly cleaned to remove any fleshings, etc. that may be in it.

'After the hides are drained, they are stretched on large rigid wooden frames by inserting small S-shaped iron hooks in the already existing holes or notches and by fastening these hooks and the frame with a strong rope (fig. 10). In spite of the frames being made of wood, the corners are strengthened by providing supports. After the hides are properly stretched, the superfluous liquid is removed from both sides with a small wooden board, which also helps to give a glossy finish.

'The hides are next placed for drying. Here also great care is exercised. Direct or bright sunlight is avoided as there is a possibility of the hides being overheated at certain places and becoming gelatinous. In the morning or during the cooler hours of the day, the frames are placed flat, but during the day the frames are put in such a way that the sun shines obliquely on the hides (fig. 11). Further drying is effected in covered sheds, which are specially built for the purpose (fig. 12). There is no difference between the treatment of cow and buffalo hides, except for the fact that the latter takes a few days longer to finish.

'When the hides are thoroughly dry, they are removed from frames and folded in two. The hides meant for export are again immersed

for one or two minutes in arsenic solution and are dried in the sun before packing. This completes the poisoning process and safeguards the hides from attacks of vermin.'

What India may learn

From the above description and the photographs, it is clear that the curers in Java take a good deal of care and pride in preparing the hides for the market. It will be observed that, unlike the case in India, in Java great stress is laid on washing the hides and freeing them of all dirt, blood, etc. Fleshing is done on smooth tables and not on the ground, as is the case in India. There is method and system even in cutting the holes in order to get a good pattern, and an evenly stretched and wrinkle-free product. In India the frames are always of bamboos which sag badly and do not serve the purpose well. In Java stout wooden frames are used, which are strongly reinforced at the corners. The use of hooks between the hide and the stretching rope is unknown in this country, although this greatly facilitates the stretching and saves time and the labour of passing a long rope through each hole. The drying is finished off under specially constructed covered sheds and the product obtained is pliable, compared with the Indian dry-framed hides, which are dried throughout in the open and are so hard that they are often called 'flint-cured'. Arsenicating the hides prior to framing them and rubbing down the hair and flesh sides with a smooth board are the other noteworthy features of the Java method.

The process is commended for adoption in India as an improvement over the present haphazard method of preparing 'dry-framed' goods. In order that the process may be copied to perfection, it is essential to compare the Indian cured hides on Java pattern with those obtained from that country.

WARTIME FOOD PRODUCTION LAWS IN BRITAIN

By J. Bartley, C.S.I., I.C.S.

Additional Secretary, Legislative Department, Government of India

IN July 1939, with the clouds of impending war rapidly darkening, the Government of the United Kingdom took the first step definitely attributable to war conditions to encourage farmers to increase production and to organize agriculture for the purposes of war. The Agricultural Development Act, 1939, contained provisions aimed at fostering the cultivation of oats and barley, increasing the number of sheep bred in the United Kingdom, and promoting the ploughing up of grassland to render it fit for arable crops. It also provided for assistance to agriculturists by enabling Government to acquire and keep a supply of tractors and other agricultural machinery, and by increasing the Government grant to the Company formed under the Agricultural Credits Act, 1928, for the purpose of making loans on favourable terms to farmers for agricultural purposes.

Subsidies for increased production

The method adopted to stimulate the growth of oats and barley and the breeding of sheep was the payment of a subsidy to farmers of land under these crops and breeders of sheep if the price of home-grown oats or barley or the average price of sheep fell below a certain level. This method had for several years been employed and continues to be employed to encourage the growth of wheat, and it was to be extended in 1940 to rye also by the first of the Agriculture (Miscellaneous War Provisions) Acts of that year. In order to promote sales of home-grown barley and to develop and stabilize the market, the Ministry of Agriculture was empowered to make what were called 'barley schemes' under which manufacturers of products derived from barley could be compelled to use a certain proportion of home-grown barley in such manufacture and purchasers of barley for the purposes of manufacturing barley products could be compelled to pay not less than a certain minimum price for home-grown barley covered by a certificate for which the scheme provided.

A wholesome check on incompetent or negligent cultivation was imposed by enabling the Minister of Agriculture or the provisions of the barley scheme itself to reduce any subsidy payment due to a farmer if the crop of oats or barley obtained from his land was unduly small or was prejudicially affected because the land was unsuitable, or because there was negligence in preparing the land or tending the crop.

The money required for the payment of the oats subsidy was provided wholly by Parliament as was also that required for the sheep subsidy. Under a barley subsidy scheme a special fund was constituted partly provided by Parliament, and partly raised by the levy of contributions from persons employing barley in the manufacture of barley products and from persons importing barley products. Contributions of this kind, called quota payments, had been a feature of the earlier wheat subsidy legislation which was taken as a model in dealing with oats, barley and rye, though the wheat quota payments were suspended in 1940, presumably so as not to discourage importation.

Ploughing up grassland

Moneys provided by Parliament formed the source of the grants made to persons at whose expense grassland was ploughed up during the year for the purpose of being made capable of producing arable crops for harvesting in the succeeding year. The grant was at first available only in respect of land comprised in a farm with at least two acres of such land in it, but in 1940 this limit was reduced to one acre. The grant was to be at the rate of £2 per acre. It was payable only if the ploughing took place between the 4th day of May and the end of October, but when the system was continued for subsequent

years this with other details was modified, and the benefits and protection later given to those undertaking such ploughing in response to definite orders were extended to those who had previously done so voluntarily. The land had to be land which had been under grass for a period of seven years or more; and precautions were taken to see that the land when ploughed up was dealt with, whether by fallowing, re-seeding or sowing with a catch crop in the proper way, so as to ensure that it would be brought into a condition of cleanliness and fertility. The applicant for a grant had also to satisfy the authorities that the land was capable of being substantially improved by the ploughing and other treatment given to it, and would be able to produce satisfactory arable crops for harvesting in 1940, or in the year subsequent to the ploughing.

The provisions made by this Act of 1939 have been continued during the subsequent years with the adaptations necessary to adjust them to the circumstances, and with the amendments suggested by experience. The Agriculture (Miscellaneous War Provisions) Act, 1940, which effected some of these amendments, added provisions aimed at securing the drainage of land where the machinery provided by the Land Drainage Act of 1930 was inadequate. The second Act of the same name that year supplemented these provisions. The Agricultural Wages (Regulation) Amendment Act, 1940, placed minimum agricultural wages, previously fixed by committees working separately in each administrative county, on a national basis. An Agriculture (Miscellaneous Provisions) Act of 1941 was mainly concerned with details of administration arising out of the 1939 and 1940 Acts just referred to.

Emergency powers

But the Act of 1939 did not by any means represent all the legislation undertaken in England affecting agriculture for war purposes in that year. Much more far-reaching provisions were enacted in the form of regulations made under the Emergency Powers (Defence) Act, 1939, passed on 24 August 1939. Section 1 of this Act gave power to make regulations by Order in Council for many war purposes, amongst them the securing of the efficient prosecution of the war and the maintenance of supplies essential to the community. Several regulations directly or indirectly dealing with agriculture and drastically affecting it were made in 1939 and the following years and have been supplemented by statutory rules and orders made under the regulations themselves.

Where the provisions of the Agricultural Development Act, 1939, enabled suitable forms of persuasion to be applied to entice the farming community into the paths which Government thought desirable, the regulations were framed with the object of compelling it to follow those paths. The object of the ensuing paragraphs is to indicate the nature of the provisions made and the powers taken, and the machinery used in putting them into effect.

Land under control

Of these regulations regulation 50, couched in very wide terms defining the powers exercisable over land, and providing among other things for such matters as demolition of buildings and clearance of damaged sites, enabled any person authorized by a competent authority—and the Minister of Agriculture and Fisheries is such a competent authority—to do *any work on any land* aimed at the maintenance of supplies essential to the community. Regulation 51 empowers the Minister of Agriculture amongst others to take possession of any land and to use it or cause it to be used in any manner he thinks expedient for achieving the same objects. Regulation 61 enables him to forbid the use of agricultural land for any purpose but agriculture, and makes trespass on land under crops a penal offence. Regulation 63 gives him wide powers to issue directions with respect to the cultivation, management or use of agricultural land, park land, sports grounds and racecourses with a view to increasing or maintaining the output of essential articles. His directions are enforceable not merely by the penalties to which disobedience exposes an offender, but by a power given to the Minister to terminate tenancies, a power he can also exercise if it appears to him that the tenant is not cultivating the land according to the rules of good husbandry.

Where he terminates a tenancy he can make new contracts for the occupation of the land by others. He is given powers relating to fisheries very similar to those given him by regulation 62 in respect of land, and he can vest in himself or in persons licensed by him the exclusive right of taking fish in any waters, thereby suspending existing fishing rights. He is empowered, where such action is necessary to prevent damage to crops, to order the destruction of any species of vermin, and the killing or taking of hares, rabbits and birds, and even the destruction of deer ; and he is adequately armed with power to secure that the work is done, and that the animals killed or taken shall be available for food. He can regulate and restrict the felling of trees and control the prices at which growing trees may be sold for felling.

Other regulations authorize local authorities, despite any existing legal restrictions, to adapt land occupied by them for use as allotments, to let it out to tenants or to cultivate it themselves. All restrictions imposed by leases, tenancies or contracts on the keeping of pigs, hens and rabbits are suspended. It is made an offence to allow any crop harvested from agricultural land to be damaged or to go to waste for lack of reasonable steps to keep it in good condition.

Regulation 85 enables the Minister to authorize persons to enter on any land either for the purpose of exercising any of his powers or for determining whether they are to be exercised. And regulation 66 makes a provision of the greatest practical importance, as being the origin of the War Agricultural Executive Committees by which much of the work under these regulations is carried out, by enabling the Minister of Agriculture to delegate to such extent and subject to such restrictions as he thinks fit, to any person or body of persons appointed or approved by him, all or any of his functions under most of these regulations.

Treatment of fenlands

The extensive nature of the powers given by these regulations is sufficiently apparent from their terms as briefly indicated above. An illustration of their application is afforded by the treatment of fenlands. The fenland districts of England include large tracts of potentially productive land which has not hitherto been used for crops, or even in places for grazing, because of the lack of efficient roads and adequate drainage. The power given by regulation 50 ' to do any work on any land ' was used to carry out the construction of proper roads on fenlands. The Land Drainage Act, 1930, already provided machinery which could be utilized to secure the drainage of fenlands, and to recover the costs by means of owners' drainage rates and occupiers' drainage rates. These drainage powers were supplemented by the first of the two Agriculture (Miscellaneous War Provisions) Acts of 1940, and further developed by the second. They provided for the recovery, from owners benefited by the construction of roads over fenlands or drainage works in fenlands, of the cost of the conversion of grassways into hard roads and the construction of drainage works, recoveries being spread if necessary over a period of five years. To ensure the permanence of the work done, the maintenance of the roads as well as of the drainage works was entrusted to the drainage authorities constituted under the Land Drainage Act, 1930. The power given by regulation 62 to issue directions with respect to the cultivation, management or use of agricultural land enabled the Minister to compel persons to plough up grassland, where previously they had only been encouraged to do so by the offer of a bonus, but had to some extent been deterred from doing so by conditions in their tenancies requiring them to pay a penal rent unless they obtained the previous consent of the landlord. Even customary, private or public ways over land could be so ploughed up. The Minister could direct certain crops, or certain amounts of a particular crop to be grown, and he could limit the amount of any particular crop that might be grown. He did so limit the cultivation of soft fruit rhubarb, culinary herbs, flowers and mushrooms,[1] hops[2] and mustard,[3] and prohibited

[1] Statutory Rules and Orders, 1940, No. 632.
[2] S. R. & O. 1940, No. 2084.
[3] S. R. & O. 1940, No. 2181.

the cultivation of strawberries[1] and of flowers[1] in glasshouses. The rearing of pheasants[2] by artificial means was also restricted. Dates were fixed before which potatoes[3] of various varieties were not to be lifted.

War Agricultural Executive

For the proper exercise of powers such as these the necessity for some agency in close touch with local conditions to which the Minister's powers could be suitably delegated is obvious. Considerable powers under regulation 51 (taking possession of land) were delegated to the London County Council itself, and to other borough councils. But the chief instrument used was the War Agricultural Executive Committees, appointed by the Minister for the various administrative counties, but with power also to operate in county boroughs surrounded in whole or in part by the administrative county. Comparatively simple provisions governing their constitution and procedure were laid down in the order under which they were set up,[4] and the restrictions imposed on their exercise of the powers given to the Minister by the regulations and transferred to them by delegation, were very moderate. A mere authorization by the Minister was sufficient to enable them to exercise the powers given by regulation 50. To them were at once delegated the Minister's powers under regulations 51, 62 and 85[4], his powers under regulation 63 for securing the killing of game and pests so far as rabbits, rooks, wood-pigeons, rats and deer were concerned,[5] his powers under regulation 62BA to require the removal of livestock from land for agistment elsewhere and to require the agistment of livestock on any land.[6] They were used in applying the orders limiting the growing of certain crops by being empowered to grant permission to exceed the limitations imposed,[7] or to grant licences to do the things prohibited, as for instance the

[1] Statutory Rules and Orders, 1940, Nos. 632, 968, 2061.
[2] S. R. & O. 1940, No. 1128.
[3] S. R. & O. 1940, No. 1208.
[4] S. R. & O. 1939, No. 1078.
[5] S. R. & O. 1940, Nos. 431, 585, 866, 966, 967.
[6] S. R. & O. 1940, No. 1602.
[7] S. R. & O. 1940, Nos. 632, 968.

lifting of potatoes[1] before the dates fixed as those on which it is lawful to lift them, or the growing of hops[2] or mustard.[3] They were also used as the machinery to register and control the work of agricultural contractors, that is persons whose principal business is that of cultivating and carrying out agricultural operations on the lands of others, when measures of control over these were introduced by the Agricultural Contractors (Registration and Control) Order, 1940.[4] Similarly, when the Minister took power[5] to fix the number of livestock to be kept on a particular piece of agricultural land and to order the disposal of particular livestock by slaughter or otherwise, the War Agricultural Executive Committees were vested with the Minister's powers subject to his control in limited respects. Where a person has failed to comply with any directions issued by a Committee, the Committee is empowered to enter on the land and do the work itself.[6]

These functions given by or under the regulations do not exhaust the list of the Committees' functions. Under the provisions relating to ploughing grants contained in the Act of 1939 and continued and expanded by the Acts of the subsequent year, they are, for the purpose of deciding whether a person is entitled to a ploughing grant, the judges of whether the land ploughed up has been satisfactorily re-seeded.[7] Under the land drainage provisions of the two Agriculture (Miscellaneous War Provisions) Acts of 1940 they are given important powers. They can, for instance, initiate drainage schemes, when they consider that agricultural land will be benefited, by requesting the Catchment Board for the area to prepare and execute such schemes;[8] and they can receive from owners or occupiers of land proposals for field drainage or the cleansing or improvement of ditches,[9]

[1] S. R. & O. 1940, No. 1208.
[2] S. R. & O. 1940, No. 2084.
[3] S. R. & O. 1940, No. 2081.
[4] S. R. & O. 1940, No. 1333.
[5] S. R. & O. 1941, No. 795.
[6] S. R. & O. 1940, No. 1197.
[7] S. R. & O. 1940, No. 2181.
[8] Section 14, Agriculture (Miscellaneous War Provisions) Act, 1940.
[9] Section 15, Agriculture (Miscellaneous War Provisions) Act, 1940, as amended by section 1 of the second Act of that name.

and if they give their approval to the scheme, can ensure for the person carrying out the scheme a Treasury grant towards the expenditure incurred.

Further experience may be required to show how far the Agricultural War Executive Committees will succeed in efficiently exercising these extensive powers and discharging these heavy responsibilities. Legislation has proceeded tentatively and experimentally, and there is as yet no sign of any misgivings in Parliament as to their competence and usefulness.

GRAPEVINE VARIETIES AT LYALLPUR

By

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and

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IN an article in *The Indian Journal of Agricultural Science*[1] on the distinguishing characters and behaviour of some grapevine varieties tried at Lyallpur, the authors presented a detailed description of 66 varieties. Since then, many more have fruited, and the present communication includes the new ones as well as an abridged account, in popular language, of those previously described. The total number of varieties dealt with here is 112.

The variety collection plot at Lyallpur has served its primary purpose of providing the most suitable varieties for the conditions obtaining in the Punjab. It also affords a nucleus for originating new varieties by crossing, which work is now in progress, under a scheme financed jointly by the Punjab Government and the Imperial Council of Agricultural Research. It offers a potential field for disseminating varieties throughout India. The latter point is likely to interest those who are trying to obtain, from far off countries, the very material that can be sent from Lyallpur at an insignificant cost and without any loss of time.

The possibilities of viticulture in India are discussed at length in the Government of India publication, Marketing Series No. 20—AMA 11/1000. This has rightly tended to stimulate interest in some quarters, as there evidently is a need for the trial of this fruit under vastly varied conditions obtaining in this country. The object of this article is to bring to the notice of all concerned the richness of the material available for trial, a brief description of which, as given here, should serve a useful purpose for selecting suitable sorts.

[1] Vol. X, Part IV, 1940.

Description of varieties

All the varieties existing in the collection area are described irrespective of the fact whether they have been successful or not under conditions prevailing at Lyallpur, because it has been generally observed that some varieties failing at one place do very well under other conditions. Secondly, since detailed botanical description of about half of the varieties has already been given by the authors, the description given here is brief and of a popular nature.

The experience shows that varieties having hairy (felt-like pubescence) leaves are hardy and resistant to many diseases. Those with solid texture of the berry are also found generally unsusceptible to berry diseases like mildew, anthracnose, etc. Varieties with glabrous (non-hairy) and thin leaves have been generally found to show signs of distress in seasons of drought, although they usually recover readily when favourable conditions are restored.

The terms early, mid-season and late are naturally used in a comparative sense. Varieties ripening before or by the first week of June are described as very early, those ripening by mid-June as early, by mid-July as mid-season, by end of July as late and those ripening after this are termed as very late. In fact, there are some varieties that do not ripen under Lyallpur conditions.

The question of ripening period is very important. In the Punjab plains, the monsoon begins by the middle to the end of July in various parts of the province. Some parts get good rains and others light. The Punjab is naturally interested in early ripening varieties

which may escape damage by monsoon rains which is the main limiting factor to the successful production of grapes in this province. It need hardly be mentioned that period of ripening in other provinces for these grapevine varieties may not synchronize with the advent of the monsoon. It is also possible that in some places late varieties may prove even better, but drier tracts should always be preferred for the cultivation of this fruit.

(1) *Agawam.*—Heavy grower, medium cropper and resistant to diseases; the chief defects are thick skin and solid texture of pulp; mid-season variety.

(2) *Angulata.*—Heavy grower, medium cropper and resistant to diseases; quality moderate; mid-season.

(3) *Almeria.*—Heavy grower, does not ripen properly under Lyallpur conditions, adaptable to hot interior regions in California.

(4) *Amber Queen.*—Very heavy grower, light cropper, quality moderate; mid-season.

(5) *Bakator.*—Hungarian wine grape; heavy grower, medium cropper and resistant to diseases; likely to prove a desirable table variety at higher altitudes in India.

(6) *Beau Blanc.*—Poor grower; light cropper; mid-season.

(7) *Bedana.*—Heavy grower, medium cropper, susceptible to anthracnose; bunches very attractive; early; seedless; likely to grow successfully as a table variety under varied conditions.

(8) *Bellino.*—Qualities commending it are attractive colour and rich aroma, otherwise very seedy and small-sized berries; early.

(9) *Bhokari.*—Heavy grower and heavy cropper; quality moderate; mid-season.

(10) *Black Damascus.*—Heavy grower; light to medium cropper; resistant to diseases; appearance attractive and aroma rich; skin thick and cracking; late.

(11) *Black-Prince.*—Heavy grower, good cropper and resistant to diseases; large-sized berries with sweet and rich aroma; bunches rather loose; early; one of the best and deserves trial everywhere.

(12) *Black-Prince (Calif.).*—Quite different from real Black-Prince; easily the best grower; bunches large and compact; sweet but lacks aroma; mid-season.

(13) *Black Hamburg.*—Resembles Black-Prince in every respect but flavour not quite so well marked; supposed to be a variety having tender skin, but it is thick-skinned with us.

(14) *Buckland's Sweet Water.*—Vines of medium vigour; berries attractive, having spherical shape and pinkish yellow colour; medium cropper; mid-season.

(15) *Black Quetta.*—Heavy grower, light cropper, mid-season.

(16) *Black Muscat.*—Heavy grower, medium cropper, mid-season, rich aroma.

(17) *Black Monakka.*—Heavy grower, rather light cropper, excellent quality, mid-season, a black grape which is almost seedless.

(18) *Black Diamond.*—Plants still young and so have not fruited so far.

(19) *Banqui Abyad.*—Vines of medium vigour, medium cropper, quality moderate, early.

(20) *Bailey.*—Vines of medium vigour, medium cropper, texture firm, insipid, early.

(21) *Beacon.*—Vines of medium vigour, good cropper, texture firm, unpleasant aroma, mid-season.

(22) *Brilliant.* Vines of poor vigour, medium cropper, texture firm, unpleasant aroma, mid-season.

(23) *Bangalore Blue.*—Plants still young and have not borne any crop so far.

(24) *Chasselas Rose.*—The famous wine-grape variety grown extensively in France; vines of slender vigour; bunches compact and small-sized; quality good; mid-season.

(25) *Chaouch.*—One of the most heavy growers and heavy croppers; susceptible to anthracnose; early.

(26) *Cornichon.*—Heavy grower; light cropper; late.

(27) *Cipro Nero.*—Heavy grower; light cropper; late.

(28) *Chandukhani.*—Planted only a year ago.

(29) *Convent Large White.*—Vines of medium vigour, light cropper, mid-season.

(30) *Convent Large Black.*—Very heavy grower, medium cropper, mid-season.

(31) *Catawba.*—Has not yet fruited.

(32) *Chasselas Neuschatel.*—Vines of poor vigour, light cropper, early.

(33) *Concord.*—Widely grown in America, lacks flavour and aroma, vines of medium vigour, very late, susceptible to drought.

(34) *Campbell Early.*—Planted only a year back, supposed to be a grape of high quality.

(35) *Canada.*—Very heavy grower, medium cropper, sub-acid, mid-season. It has little value as a dessert fruit, used for making red wine and grape juice in U. S. A.

(36) *Carman.*—Vines of medium vigour, light cropper, texture solid, mid-season.

(37) *Champanel.*—Has not yet fruited.

(38) *Dakh.*—Heavy grower; heavy cropper (fig. 1) resistant to diseases; berries black with blue bloom; bunches compact; mid-season; excellent for juice-making.

(39) *Damas Rose.*—Heavy grower; medium cropper; bunches and berries large-sized; late.

(40) *Danugue.*—Very heavy grower, medium cropper, late.

(41) *Diamond Jubilee.*—Heavy grower; good cropper; insipid; mid-season.

(42) *Dizmar.*—Heavy grower; light-cropper, mid-season.

(43) *Doite-de-Dessie.*—Vines of medium vigour; very light cropper, late.

(44) *Delaware.*—Planted only a year back, commonly grown in U. S. A. as it is a very hardy variety.

(45) *Dattier-de-Beyrouth.*—Planted only a year back, supposed to be a very pretty grape with large bunches and berries.

(46) *Emperor.*—Standard shipping variety of the Pacific slope; vines of poor vigour, medium cropper, poor quality, early.

(47) *Ellen Scot.*—Heavy grower, heavy cropper, quality moderate, mid-season.

(48) *Fakadi.*—Very heavy grower; heavy cropper; sub-acid; mid-season.

(49) *Foster's Seedling.*—Vines of medium vigour; good cropper; bunches loose; rich and sweet aroma; seedy; early.

(50) *Flame Muscat.*—Heavy grower, medium cropper, excellent quality, mid-season.

(51) *Fern Munson.*—Has not fruited so far.

(52) *Gatak.*—Very heavy grower; very light cropper, mid-season.

(53) *Gros Colman.*—Heavy grower; heavy cropper; late. It has the reputation of being the handsomest black table grape in U. S. A., and has the largest berry of any round grape.

(54) *Gros Sapat.*—Vines of medium vigour; medium cropper; mid-season, quality fair.

(55) *Green Large Seeded.*—Heavy grower, very light cropper, late, quality good.

(56) *Gujranwala.*—Heavy grower, very light cropper, insipid, mid-season.

(57) *Goethe.*—Heavy grower, medium cropper, mid-season, rich aroma.

(58) *Hur.*—Very heavy grower, medium cropper; late.

(59) *Hussaini Black Kabuli.*—Very heavy grower; medium cropper; berries large, black coloured with blue bloom, texture solid; mid-season.

(60) *Hussaini.*—Vines of medium vigour, very light cropper, mid-season.

(61) *Haitha.*—Planted only a year back.

(62) *Iona.*—Vines of poor vigour; a very light cropper but the fruit has a rare combination of sweetness and acidity; mid-season.

(63) *Isabella.*—Heavy grower, medium cropper, quality moderate, mid-season.

(64) *Jaishi.*—Heavy grower, good cropper, mid-season, quality poor.

(65) *Kali Sahebi.*—Heavy grower, very light cropper, late, texture solid; insipid.

(66) *Kandhari.*—Very heavy grower, medium cropper, mid-season, bunches and berries large and attractive.

(67) *Kartilaska.*—Very heavy grower, light cropper, insipid, late.

(68) *Khalili.*—A fairly vigorous grower, light cropper, very early.

(69) *Khari-murat.*—Heavy grower, light cropper, insipid, mid-season.

(70) *Kishmish White.*—Heavy grower, light cropper, good quality, early.

(71) *Kishmish Red.*—Heavy grower, light cropper, mid-season.

(72) *Luglienga.*—Vines of poor vigour, light cropper, early.

(73) *Lomanto.*—Heavy grower, heavy cropper, quality moderate, early.

(74) *Madeleine Angevine.*—Vines of medium vigour, medium cropper, quality good, the earliest of all varieties tried at Lyallpur.

(75) *Madresfield Court.*—Vines of poor vigour, light cropper, excels all others in

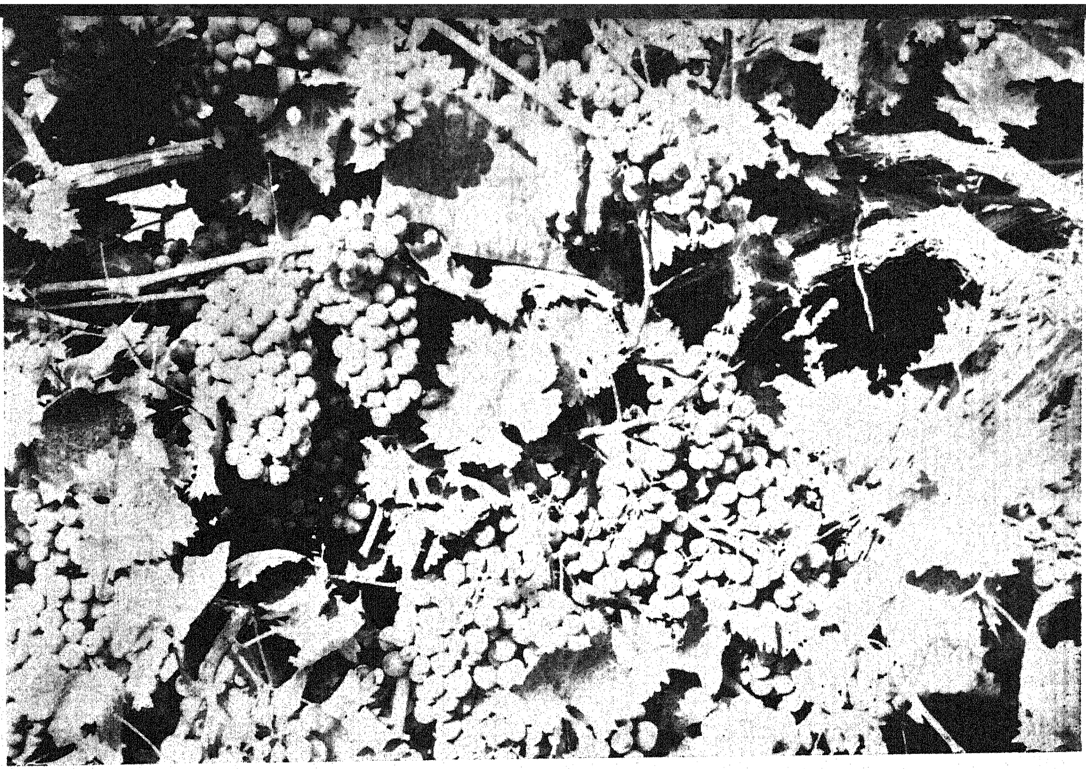

FIG. 1. Bearing of Dakh
(Note bumper crop, bunches medium-sized, long, pyramidal, single or divided, usually compact)

FIG. 2. Bearing of Pandhari Sahebi
(Note attractive bunches, which are long, pyramidal, single and compact)

respect of richness of aroma and sweetness; mid-season.

(76) *Malaga.*—A favourite table and raisin grape in California. Heavy grower, medium cropper, fairly late.

(77) *Mavron.*—Heavy grower, medium cropper, quality fair, rather late.

(78) *Muscat of Alexandria.*—Vines of medium vigour, medium cropper, noted for richness of aroma and sweetness, mid-season. The leading table and raisin grape of the Pacific slope.

(79) *Mission.*—Heavy grower, heavy cropper, delicious, mid-season.

(80) *Minnie.*—Vigorous grower, has not fruited so far.

(81) *Mericadel.*—Heavy grower, light cropper, aroma not agreeable, mid-season.

(82) *Oliveth-de-Vandemain.*—Heavy grower; being very late, the fruit does not ripen at Lyallpur.

(83) *Palomino.*—Grown commonly in California as a table grape. Heavy grower, heavy cropper, quality good, mid-season.

(84) *Pandhari Sahebi.*—Very heavy grower; a self-sterile variety but quite a heavy cropper when grown with self-fertile varieties; noted for attractiveness of bunches and berries (Fig. 2); mid-season; texture firm; insipid.

(85) *Pay Kani.*—Heavy grower, light cropper, mid-season.

(86) *Portuguese Blue.*—Vines of medium vigour, light cropper, mid-season.

(87) *Prunede Cazoul.*—Heavy grower, medium cropper, fairly late, quality fair.

(88) *President.*—Vines of poor growth, medium cropper, flavour not agreeable, mid-season.

(89) *Queen Golden.*—Vines of medium vigour, medium cropper, late.

(90) *Ribier.*—Very heavy grower, fairly heavy cropper, mid-season, fairly good quality.

(91) *Rish Baba.*—A white Persian variety long grown in California. Very heavy grower, light cropper, mid-season, quality good, requires long pruning.

(92) *Rose.*—Heavy grower, light cropper, mid-season, quality good.

(93) *Rose of Peru.*—Very late to sprout in spring, cannot stand Lyallpur climate.

(94) *Rose of Lahore (M. T).*—Heavy grower, medium cropper, quality moderate, mid-season.

(95) *Servan.*—Very heavy grower, medium cropper, late.

(96) *Spin Savai.*—Heavy grower, very light cropper, mid-season.

(97) *Sultana.*—Heavy grower, light to medium cropper, noted for attractiveness of bunches and berries, fairly early, seedless.

(98) *Sur Savai.*—Heavy grower, light cropper, mid-season.

(99) *Sheikh Ali.*—Vines of medium vigour, medium cropper, quality good, mid-season.

(100) *Sultanina Rosea.*—Planted only a year back.

(101) *Sheridan.*—Vines of medium vigour, has not so far fruited at Lyallpur.

(102) *Tandah.*—Heavy grower, light cropper, mid-season.

(103) *Tas.*—Heavy grower, light to medium cropper, insipid, late.

(104) *Tor.*—Heavy grower, light to medium cropper, mid-season, quality fair.

(105) *Trentham Black.*—Vines of medium vigour, very light cropper, mid-season, quality good.

(106) *Tandan.*—Heavy grower, light cropper, mid-season, quality good.

(107) *Thompson's Seedless.*—Heavy grower, medium cropper, attractive bunches and berries, seedless, fairly early, supposed to give heavy yield on heavy soils with long pruning.

(108) *Tokay.*—Heavy grower, light cropper, late, quality moderate.

(109) *Waltham Cross.*—Very heavy grower, medium to heavy cropper, late, quality good.

(110) *Wapa Nucka.*—Vines of medium vigour, light cropper, mid-season, quality moderate.

(111) *Zante currant.*—Heavy grower, light cropper, berries very small, quality very good, fairly early, seedless.

(112) *Zinfandell.*—Vines of poor vigour, light cropper, sub-acid, mid-season.

NANDED COTTON GROWERS EARN RS. 24 LAKHS EXTRA

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GAORANI cotton in Nanded district has for long been famous for its fineness and excellent spinning properties. Until recent years it has been in great demand from the Indian mills. With the production of other equally good varieties in the adjoining British provinces and the rapid extension of the area under them, the grower of Gaorani cotton is faced with keen competition. Low yields, dirty picking, lack of adequate marketing facilities and indifferent handling of the produce are other factors that have conspired to reduce the profit from its cultivation. As the bulk of the cash income of Nanded farmers is derived from cotton, it is evident that the improvement of this crop is the *sine qua non* of any increase in his earnings.

Notable achievement

The Hyderabad Government recognized the importance of this question many years ago, and, with a grant from the Indian Central Cotton Committee, initiated Gaorani improvement work in 1929. As a result of sustained scientific work and comparative trials at the Cotton Research Station, Parbhani, an improved strain, Gaorani 6, was produced in 1934. During the next three years the new strain was tested against the local variety in the cultivators' fields of several villages of Nanded district. It was found to be the better of the two varieties in most of the trials. Simultaneously, the new variety was demonstrated to the cultivators of the tract deemed suited to its growth. This convinced the growers of its greater yield. The subsequent rapid expansion of the area under it is an achievement of which the Hyderabad Department of Agriculture and the Indian Central Cotton Committee can justly feel proud.

The higher monetary return to the cotton farmer does not depend solely on the improvement of yield. The improvement of quality of cotton and the disposal of the produce at the maximum price obtainable also play an important role. Since cotton is grown only to sell, the farmers' interest in the improved variety will be the greater if its produce also fetches a better price. Very often in the past, the planting of improved varieties has not had encouraging results because of the commercial custom of indiscriminate buying. This signifies that the improvement of production and of the marketing system must go together.

Maintenance of purity

For the improvement of quality, the Hyderabad Department of Agriculture distributes annually large quantities of pure seed of the new variety and arranges to have it sown in a gradually extending compact block to the exclusion of the ordinary Gaorani. The exclusion of the unimproved variety prevents hybridization as well as the deterioration of the stocks of pure seed by the intentional mixing of inferior cotton with the produce of the improved variety. This precaution against mongrel breeds has been recognized as an essential requirement for establishing and maintaining the cultivation of improved Gaorani. Accordingly, a special organization has been set up for the continued production of pure seed, extending from a nucleus plot at the Cotton Research Station to thousands of acres of the cultivators' crop in the area specially reserved for the purpose. The seed is supplied on *taccavi*, the cost being recovered in easy instalments. As a result of these arrangements, the quantity of pure seed distributed has increased from about 8,000 lb. in 1935-36 to a little over 5,600,000 lb. in the 1941-42 season. The seed distributed in 1941 is valued at Rs. 1,30,000 and is deemed sufficient to sow nearly 350,000 acres.

To obtain a fair reward of the due price for the better quality and ginning outturn of the new variety, the Government has also made

adequate arrangements for ensuring the purity of cotton in its march from the field to the factories. Annually the crops of a large area are inspected and off-type plants removed from the fields. Furthermore, the petty buyers in villages are licensed, the transport of improved *kapas* to the markets is controlled, its ginning and pressing are supervised, every bale is numbered and given the distinctive mark, and certificates of purity are issued for such marked bales to their owners. The utility of these measures has been recognized by both the traders and the consumers of this new cotton, so much so that a greater part of the funds required for their adoption is supplied by the buyers and commission agents by a voluntary contribution based on their transactions of the produce of the new variety.

The planting of a single variety of cotton and the steps taken in cooperation with the trade for producing regular supplies of guaranteed purity have created a community of interest between the cultivators, traders and consumers. To make this community of interest more conscious, a Cotton Cooperative Union was established in 1939 at Nanded and charged with the duty of supervising the daily auction sales and the ginning and the pressing of the produce of a large part of the area. The Union was also authorized to number the bales, affix a distinctive mark on them and issue certificates of purity for the marked bales. The members of the Union consist of cultivators, merchants, commission agents as well as textile manufacturers.

Rs. 24 lakhs extra

In consequence of the better yield per acre, the higher ginning outturn and guaranteed purity of produce, the growers of the new variety have earned a substantial additional income each year. The improved variety gives on an average about 10 per cent more yield than the ordinary variety and its produce fetches a premium of 10 to 17 per cent in price. Calculations based on its greater yield per acre, the daily sales of *kapas* and the higher prices paid for the new cotton show that the growers of Gaorani 6 earned the following additional income during the past four seasons :

	Rs.
1937-38	1,10,000
1938-39	1,23,000
1939-40	11,00,000
1940-41	11,00,000

This additional income of about Rs. 24 lakhs in four years is about five times the total expenditure incurred on Gaorani improvement work since its inception twelve years ago.

SUGARCANE PYRILLA

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SUGARCANE pyrilla is indigenous to India. It sprang into prominence for the first time in 1900 when it was 'reported as a pest of sugarcane from the North Arcot district in South India '.[1] In subsequent years it secured a place in the front line of our destructive insect pests by the sheer weight of injuries which it inflicted on the sugarcane crop in different parts of India. From the evidence at hand it seems that its potentialities for damage find their fullest expression with the cultivation of new and better-yielding varieties of sugarcane. By persistent and careful effort a great deal of useful information has been collected about this pest in the Punjab, and measures, which ensure considerable abatement in the losses inflicted by it, have been devised. The present article embodies all this information. But there is room for considerable improvement in the methods designed to combat it and the Imperial Council of Agricultural Research is spending large sums of money to effect this improvement.

Pyrilla is widely distributed in the sugarcane-growing tracts in India. It appears to flourish under conditions of comparatively low temperature and high humidity.

It feeds on eleven different members of the grass family but shows definite preference for sugarcane, *chari* (*Andropogon sorghum*) and maize to which it does considerable damage in certain years.

Life-history

Duration of the various stages, periods of activity, etc. discussed under life-history and seasonal-history are true for the Punjab. In other parts of India, however, these may show local variations which it will be for the entomologist concerned to investigate. The adults are yellowish brown in colour and measure $\frac{1}{3}$ in. in length and $\frac{3}{4}$ in. in the spread of their wings. Their head is drawn out into an elongated process and the apices of their front wings are of dark-brown colour, the intensity of this coloration depending upon the state of maturity of the reproductive organs. They live for 27 to 130 and 200 days, with an average of 80, the females usually living longer than the males. In nature the males preponderate over the females in the ratio of about 2 : 1.

Egg-laying

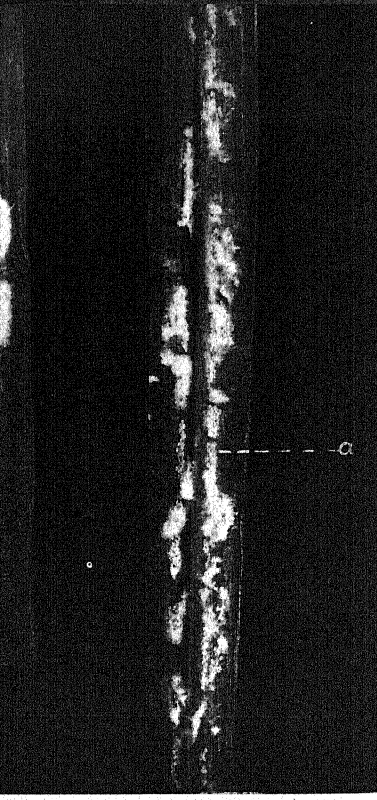
The females do not begin to lay eggs immediately on attaining their wings but wait for 13 to 25 and 24 to 47 days during the period from April to October and November to December respectively.

Each female is capable of laying 37 to 773 eggs with an average of 330, in its lifetime. They lay the largest number of eggs in May and October. The eggs are laid by instalments in clusters of 20 to 50 eggs, a female taking 15 to 126 days, depending upon the season, to lay the full quota of its eggs. Season of the year determines the place where eggs are to be laid; in summer they are laid on the underside of leaves near the mid-rib (Plate 85, fig. 1*a*) while from the middle of August onwards they are mostly laid on the inner side of the sheathing bases of the leaves. In years of heavy outbreak, however, they may be laid on any part of sugarcane and other food-plants as well as indiscriminately on roadside trees, hedge-row plants, weeds, and even on the soil. When the requisite number of eggs have been laid in a cluster, a female covers it up with whitish waxy threads (fig. 1*b*) from the brush of hairs situated at the tail-end of its body; spent females are without this brush of whitish hairs.

Eggs are oval in shape, and pale white to light bluish when freshly laid; but, when about to hatch, they become brownish in summer and darker in winter.

The eggs hatch into the young ones called

[1]C. S. Misra, *Memoirs of the Department of Agriculture, India*, 1917, Vol. 5, p. 73.



Left:
FIG. 1
Egg-cluster
(a) exposed
(b) covered with whitish waxy threads

Right:
FIG. 2. Sugarcane damaged by pyrilla

Right:
FIG. 2. Healthy sugarcane

Left:
FIG. 3. Stripped canes damaged by jackals

FIG. 4. Catching pyrilla with hand-nets

FIG. 6. Hopper dozer in action

Left : FIG. 5. Catching pyrilla with field-bag

nymphs (meaning 'a graceful young lady') in 7 to 12, 20 to 29 and 25 to 41 days from April to October, mid-October to mid-November, and mid-November to December respectively.

The nymphs possess a characteristic appearance : their head, like the adults, is drawn out into a distinct process, their two hair-like feelers project sideways from underneath their two large prominent eyes, the tail-end of their body is furnished with two prong-like processes which are called anal threads.

The nymphs are very active ; they hop or jump on slight disturbance. They run forwards, backwards and sideways with equal facility. They congregate on leaves, particularly on those which are just drying up. The reasons which prompt these nymphs to collect on drying leaves need investigation. They grow from a length of 2·4 mm. to 11·4 mm. (inclusive of the anal threads). The nymphs produced in summer are greenish white to begin with ; but, as they grow older, they change from pale white to pale brown, full-grown nymphs becoming dirty yellow : those produced in winter are of a smoky colour when young, changing to dull brown, and then to white straw-brown, full-grown nymphs being yellowish tinged with a smoky hue.

The nymphs moult five times before attaining the winged stage. From April to September the five stages average 7 to 11 days each, with a total period of 28 to 69 days, those appearing in October average 17 to 41 days, with a total period of 160 ; and those hatching in January 14 to 32, with a total of 103 days.

Seasonal history

Pyrilla has generally three, rarely four, broods a year. From January to the third week of March it is generally present in its nymphal stage. The eggs which may be found during January and the beginning of February are usually those which had been laid during November-December. With the harvesting of sugarcane, the nymphs begin to migrate to wheat, barley, oats, etc. on which they feed and change into winged adults in March-April. After the cereals are harvested in April-May these adults fly back to the sprouting sugarcane, maize and *chari* (sown for early fodder) at any time in the second half of April. From May to December all stages—eggs, nymphs and adults—of the pest are present in the fields.

Extent of damage

Adults and nymphs desap leaves (generally from their underside) which become pale and wilted : the attacked plant, thus devitalized, stops growing (Plate 85, fig. 2). They also produce 'honey-dew' which, falling on the lower leaves, provides an excellent medium for the growth of the black mould ; such leaves do not perform their function properly and efficiently. When these leaves are offered to cattle as fodder they do not eat them. But of far greater importance is the deterioration brought about by their feeding in the juice of the attacked plant ; sucrose of such plants is reduced by more than 34 per cent and the purity coefficient by 3 to 26 per cent, while the glucose ratio goes up three times. The *gur* made from this juice is of very poor quality indeed.

The pest does not attack all the varieties of sugarcane evolved at Coimbatore with equal severity : Co 300, Co 312 and Co 508 are very heavily, and Co 285, Co 395, Co 331 and Co 356 are less heavily attacked. The factors which render some varieties of sugarcane more resistant to pyrilla attack than others need investigation.

Methods of control

Pyrilla can be controlled as follows : (1) *Insect enemies.*[1]—Pyrilla is destroyed by a number of insect enemies in the various stages of its life-cycle. Of these its eggs parasites (called *Ooencyrtus papilionis* Ashm. and *Tetrastichus pyrillae* Craw) exercise a definite check on it. The eggs of pyrilla with the parasites in them become black. Leaves bearing such eggs should be collected and placed in a receptacle which should be kept in the sugarcane fields. A piece of muslin tied round the mouth of this receptacle will keep back the destructive nymphs (hatching out from unparasitized eggs) but will allow the parasites to escape and carry on their good work in the fields.

[1] C. S. Misra (1917) was the first to recommend the use of these enemies of pyrilla for its control.

Stripping of dry leaves

From the middle of August onwards the pest lays most of its eggs on the inner side of the dry sheathing leaves of sugarcane. It was observed in 1935[1] that when such leaves were removed (from Co 244) the pest laid very few eggs on the stripped canes. Richards[2] observed this behaviour of the pest 'prior to 1935'. This observation was put to test as a weapon for fighting pyrilla on Co 312 (grown on ridges in rows two feet apart) from 15 August to 15 November in 1938-39 and 1939-40 on an extensive scale and it was found that it did not fulfil the promise which it held out (for controlling pyrilla) when it was first discovered. The following points which came to light during these trials invalidate its adoption as a measure to fight pyrilla, at least in the Punjab : (*a*) it costs Rs. 35 to 44 to strip leaves from an acre of sugarcane, (*b*) 8·5 per cent of the 'eyes' or buds of the stripped canes are killed by frost during winter, (*c*) 3 to 4 per cent of the canes are damaged by the labourers while stripping the dry leaves, (*d*) 44 per cent of the stripped canes are damaged (fig. 3) by jackals and (*e*) in the absence of dry leaves the pest lays eggs on green leaves.

Readers of this article living in those parts of India which have a milder winter, cheaper labour and fewer jackals may try out this method to judge its cost and effectiveness.

Hand-nets

It has been mentioned above that after wheat is harvested, pyrilla migrates *en masse* to sugarcane, maize, and *chari* for egg-laying, the largest number of them, however, migrating to sugarcane for the purpose. Before they have laid eggs these insects should be caught with hand-nets (Plate 86, fig. 4) by sweeping them over the infested canes. The insects thus collected should be destroyed by crushing them with a brick or by dropping them in a bucket containing kerosenized water.

The hand-net is really a small bag made from a piece of muslin or light *khaddar* which is sewn on to a ring made from a mulberry branch or a young, thin bamboo stem which is, in its turn, firmly fixed to the end-fork of a 3 ft. long stick. The bag is open at one end and closed at the other; it is 15 in. to 18 in. in diameter across the mouth and is 24 in. deep.

In the central Punjab three men working for 8 hours a day can free an acre of sugarcane of this pest at a cost of about Re. 1-8. The best time to use the hand-nets during April and May is from 7 a.m. to 10 a.m. and if quick results are to be obtained or larger areas are to be treated, field bags (fig. 5) should be used in place of hand-nets.

The field bag is made from *khaddar*; it is 3 ft. wide and 2 ft. across at the mouth and 6 ft. deep and tapering behind, its extreme end being made of voile which prevents it from 'ballooning' during use. The mouth of the bag is fitted with wooden sticks to keep it open and to prevent its sagging off the ground during use. A bamboo stick 6 ft. long is tied to the upper edge of the mouth and its free end is used to hold the bag during operation. It costs about 14 as. to prepare a field bag. The bag is worked by one man who sweeps it over the infested crop as swiftly as possible. Its efficiency has been worked out at 200 per cent as compared to the hand-nets.

Destruction of eggs

The egg-clusters of the pest are covered with whitish fluffy threads derived from the brush of hairs at the tip of the female body. Such clusters (fig. 1) show off distinctly on the green leaves. These should be crushed between thumb and forefinger (both wrapped in muslin separately to protect them from injury from rough leaves).

Four men working 8 hours a day can clear an acre of sugarcane of the egg-clusters of pyrilla at a cost of about Re. 1-12.

Pyrilla dozer

This dozer (fig. 6) has been evolved at Lyallpur and is still under experiment. It has so far proved effective against nymphs feeding on wheat during February. The leaves are cleaned by brushes. Details of this machine are given in the *Bulletin of Entomological Research*, London, Vol. 31, p. 189.

[1]Khan A. Rahman and Ram Nath, *Bulletin of Entomological Research*, 1940, Vol. XXXI, p. 189.

[2]B. P. Richards, *Agriculture and Livestock in India*, 1938, Vol. VIII, p. 259.

PREGNANCY DIAGNOSIS IN EQUINES

By P. R. Krishna Iyer

Imperial Veterinary Research Institute, Izatnagar

HORSE-BREEDERS and veterinarians well know that, in a large percentage of mares, it is absolutely impossible to diagnose pregnancy during the first three or four months as they show no obvious physical signs of this condition. In some cases, pregnancy cannot be diagnosed until six or seven months after conception. In fact, a small percentage of mares show no physical signs of pregnancy until a few weeks before the birth of the foal.

The sexual behaviour of mares subsequent to service is not a reliable guide to the existence or otherwise of pregnancy, since the absence of oestrus (heat) cannot always be regarded as evidence of conception in these animals, as in most other mammals. Some mares do not exhibit a return of normal oestrus even after an unsuccessful service. Some thoroughbred mares in milk exhibit only one oestrus in a breeding season and, therefore, the absence of oestrus in them following a service should not always be taken as a sign of pregnancy.

Methods for diagnosing pregnancy in mares are said to have been practised from time immemorial in Arabia by certain Arab tribes who keep the details a secret and hand them down from father to son. There is, however, no authentic information regarding their reliability. Until recently, therefore, most people have had to depend entirely upon the clinical symptoms, history and sexual behaviour of the mare for pregnancy diagnosis. During the last decade, however, the widespread demand for a means of recognizing the existence of pregnancy in its early stages has been successfully met and a spectacular advance has been made in the early diagnosis of this condition in mares.

Ascheim and Zondek (1927) laid the foundation stone for the diagnosis of human pregnancy by biological methods, i.e. methods involving the use of living animals as test subjects. This work was taken up by scientists all over the world and eventually extended to animals, so that today there are over half-a-dozen different biological tests for the diagnosis of pregnancy in equines alone. Blood serum or urine samples of pregnant mares can be tested on mice, rabbits, rats or caponized fowls. Pregnancy diagnosis stations have been set up in almost all civilized countries and their usefulness has become generally recognized.

Pregnancy hormones

The tests are based upon the detection of two different 'hormones', one in the blood serum and the other in the urine of pregnant mares. The term 'hormone' is applied to certain substances which are produced by various ductless glands of the body such as the pituitary, the suprarenals, the thyroid and the thymus. In other words, hormones are the internal secretions of these glands and these secretions are poured by them directly into the blood stream. Recent investigations have established the fact that all the physiological functions of the reproductive organs are entirely controlled by the internal secretions of the anterior part of the pituitary gland. The two hormones referred to above, on which the test depends, are (*a*) the gonadotropic or sex-gland-stimulating hormone found in the blood serum, and (*b*) oestrin, a heat-inducing or oestrogenic hormone found in the urine of pregnant mares.

The amounts of gonadotropic hormone and oestrin present in the blood serum and urine respectively of mares vary from mare to mare and from time to time. Thus the gonadotropic hormones are found in the blood serum from the 45th to the 100th day after conception. After the 100th day, they gradually decrease in amount and disappear entirely from the blood stream by about the 120th day. From the 40th to 60th day after conception the amount of oestrin present in the

urine of many mares may not greatly exceed the amount excreted by non-pregnant mares. From the 60th day, the oestrin content steadily increases until, in the advanced stages of pregnancy, there are present about 200,000 mouse units per litre. Indeed, urine from pregnant mares is nowadays used commercially for the production of oestrin for physiological and therapeutical purposes.

The sex-gland-stimulating hormones are responsible for the growth of the sex glands and for the production of those changes which are associated with sexual activity, particularly those affecting the ovaries of the female and the testicles of the male. Oestrin when administered to a mouse, from which the ovaries have been removed, provokes certain characteristic reactions normally associated with oestrus in that animal and it is these reactions which are looked for in making a pregnancy diagnosis.

Tests with blood serum

Mice test.—The test requires batches of immature female mice which are injected with small amounts of mare blood serum, e.g. 5 or 6 drops injected twice a day for three days. The mice are killed on the fourth day and their ovaries are examined. If the concentration of gonadotropic hormone in the serum has reached the level expected in pregnancy, white spots and blood splashes are discernible in the ovaries of the mice.

Friedmann's test (*Rabbit test*).—In rabbits, liberation of eggs from the ovary normally occurs only after mating. Therefore, to avoid errors in this test, it is necessary to keep the female rabbits isolated from the male for three weeks before use. So necessary is this precaution that some workers open up the abdomen before injection to make certain that the sex apparatus has not been naturally stimulated.

About 100 drops of blood serum are injected into the ear veins of two rabbits. Twenty-four hours after the injection the ovaries of one of these rabbits are examined. If the reaction is positive, ruptured egg sacs and blood spots will be seen in one or both ovaries. If no reaction is observed in the ovaries of the first rabbit, the second rabbit is injected intravenously with another 100 drops of blood serum and similarly examined. If a negative reaction is again obtained, the result may be regarded as reliable.

Xenopus test.—In this test, the South African clawed toad is employed as the test animal. In these animals, an injection of serum induces egg liberation.

Bitterling test.—In this test, egg liberation is induced in a small fish.

It should, however, be noted that neither of these two tests is extensively used in determining pregnancy in mares.

In view of the fact that the gonadotropic or sex-gland-stimulating hormones are present in the blood serum of pregnant mares only from the 42nd to the 100th day of conception, a negative result is of significance only if serum obtained during this period is used. Batches of immature mice may be difficult to obtain unless a mice-breeding station is close at hand. The rabbits used must have been kept isolated for about three weeks. In India, the bleeding of pregnant mares may arouse a certain amount of prejudice.

Tests with urine

Mice test (*cornification test*).—The Imperial Veterinary Research Institute carries out this test for the diagnosis of equine pregnancy to meet the requirements of horse-breeders in this country at a nominal charge of Rs. 8 per test. The test consists in demonstrating the presence of oestrin in the urine of mares by the reaction resulting from injection of such urine into mice from which the ovaries have been removed. The ovaries are easily removed and once this operation has been performed, the mice can no longer spontaneously exhibit oestrus but will only do so if injected with oestrogenic substances (i.e. those capable of producing oestrus, such as urine from a pregnant mare).

When sending a sample of urine for this test, one collected in the early morning is to be preferred, since urine, like all other body secretions, is subject to violent fluctuations in composition. The quantity and concentration of urine are closely related to the intake of water, to exercise, to the state of body metabolism and to climatic conditions. Strictly sterile urine, though not essential for the test, is desirable. In order to prevent deterioration

of the hormones during transit by bacterial multiplication, a trace of cresol (1 drop to every ounce of urine) should be added. About one ounce of urine is required. Details regarding the name or number of the mare, its breed, age and the date of its last service should be sent along with the sample.

Treatment of urine

The injection of untreated urine frequently proves fatal to the test mice, as mare's urine is rich in mucin and protein bodies. Therefore, to avoid protein shock in test mice and to prevent bacterial contamination, the sample is treated to remove these harmful factors. One gram of sulphosalicylic acid is added to 25 c.c. of urine, the mixture is then well shaken and left for about 15 minutes. This brings about the precipitation of the mucin and protein bodies and the destruction of bacteria in contaminated samples. The sample so treated is filtered and then neutralized by the addition of sodium bicarbonate. It is then diluted with twice its volume of normal saline and this dilute urine is injected into the mice.

Vaginal smears are taken from each mouse before injection. Four mice are injected subcutaneously morning and evening for three days with this dilute urine until six injections in all have been given to each mouse. The doses given to the four mice are respectively 0·2, 0·3, 0·4, and 0·5 c.c. (1 c.c. represents about 17 drops). Vaginal smears are taken on the fourth day, i.e. 96 hours after the 1st injection, fixed with methyl alcohol, stained by Giemsa's stain and examined microscopically.

A positive reaction is indicated by certain chemical and morphological changes in the cells lining the vagina. These changes, however, can only be detected by an expert.

Quantity of oestrin in mouse units

To enable one to give a diagnosis of pregnancy in a given sample of urine, the sample should contain over 1000 mouse units per litre (1000 c.c.) of oestrin. Normal non-pregnant mares do not show more than 200 to 300 mouse units per litre of their urine. Some mares in oestrus may show up to 800 mouse units and a concentration of anything over 1000 mouse units indicates pregnancy. A *mouse unit* of oestrin is the minimum quantity that is required to induce oestrus in a mouse from which the ovaries have been removed. If 1 c.c. of urine can effect this change, it means that 1 litre of urine (1000 c.c.) contains 1000 mouse units.

Miller (1935) tested over 2,000 samples of equine pregnancy urine and found that a considerable number of pregnant mares from the 55th to the 80th day after service gave very weak positive reactions during the early part of the dry season. He observed that during an excessively dry summer grass is deficient in moisture and in proteins and that hormones, particularly oestrin on which the test depends, suffer in consequence. He was able to show that the frequency of such weak reactions disappeared once the rains had broken. Another difficulty in the interpretation of results may sometimes be met with in cases of virgin mares and in some old mares which have missed two or three previous seasons. Many workers are of opinion that a good many mares do not show a sufficient amount of oestrin in their urine to give a definite reaction until the 60th day after conception. Where a negative result is obtained with a sample taken before the 60th day, a second sample should invariably be submitted for test. For such second tests this Institute charges a fee of Rs. 4 only.

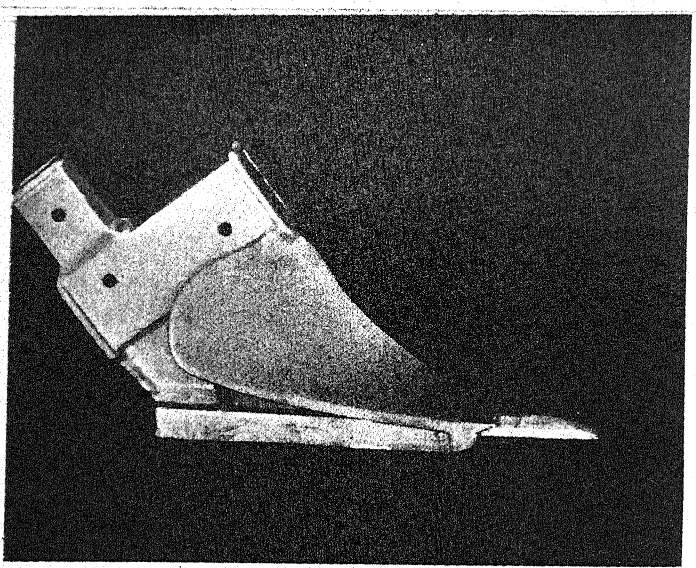
Capon test

In this test a diagnosis of pregnancy can be obtained as early as 48 hours after injection of urine. The test animal used in these tests is the brown leghorn cock from which the testicles have been removed. Fowls of other breeds cannot be utilized for this test, because other breeds of fowls do not exhibit the characteristic sex dimorphism of the characters in the plumage as the brown leghorns. In the female of this species the breast plumage is salmon coloured. In the male, the breast plumage is of a solid black colour. It is the ovarian hormone (oestrin) that is responsible for the maintenance of the characteristic pattern and colour of the female plumage in the normal female of this breed. The assumption of typical female plumage ensues in the males of this breed as a result of successful implantation of the ovary into them. The

reaction following the injection of urine containing oestrin consists in the change of the plumage type from male to female. Growing feathers are necessary for this test. Castrated birds have the faculty of rapidly regenerating plucked feathers. A dozen or so feathers are removed from an area on the breast, care being taken to ensure that the plucked feathers are solid black. In about seven days the feathers can be seen pressing the skin outwards, but not yet protruding through it. From this stage until about seven days later, the feathers are considered suitable for the test. A subcutaneous injection of 10 c.c. of the prepared urine is made on each of two consecutive days. On the third day two or three feathers are removed for examination. The feather is then pressed between a glass slide and a coverglass and examined microscopically. When the concentration of hormone has been sufficient to induce a female reaction in feathers an entire absence of black pigmentation and its replacement by red or yellow pigment occurs in the feathers. This test is rarely used.

Workers abroad have sometimes found that mares which gave positive pregnancy results on test were eventually found not to be 'in foal'. On further investigation into such cases, they obtained strong evidence that abortion had taken place in some of these mares. In a few other cases, cystic ovaries were found to be responsible for the increase of oestrogenic hormone in the urine and it was shown that any irritation or inflammatory condition of the ovary or uterus may be associated with the excretion of urine rich in oestrin. In one case a mummified foetus was found and in another the disintegrating remains of a foetus. In such cases, where there is neither abortion nor any ovarian abnormality, Miller suggests that vitamin E deficiency in the diet of the mare may cause the death and atrophy of the foetus, since it is known that deficiency of vitamin E may cause miscarriage in some, particularly working animals.

None of the biological tests enumerated above can be said to be invariably reliable, since 'invariability is not a biological phenomenon' and a certain percentage of error must be allowed for. It is certain, however, that in the great majority of mares an early diagnosis of pregnancy can be made by the use of one or another of these methods.



IMPROVED PLOUGHS

Sobkam No. 2 plough

This is a heavy plough both in weight and draft. It works at an angle the same as the *desi* plough and is fitted with a long bar share which can be adjusted year by year as it wears at the point. It is recommended for laterite but not for alluvial soils. This plough, which has become very popular in Bengal, is a general purpose plough. It turns the soil very well. The plough costs Rs. 7-8 complete.

All-metal C type light plough

This is an all-metal plough—in three pieces—body, mouldboard and share. The body and mouldboard are of steel and the share of cast iron. It is a very light plough and possesses a long life—total weight 11 seers. Costs complete Rs. 8-8. It turns over the soil and is suitable for alluvial soil. Its draft is so low that it compares very favourably with that of the *desi* plough. It can be easily carried long distances on the shoulder without fatigue. It is also suitable for use with large, medium and small bullocks.

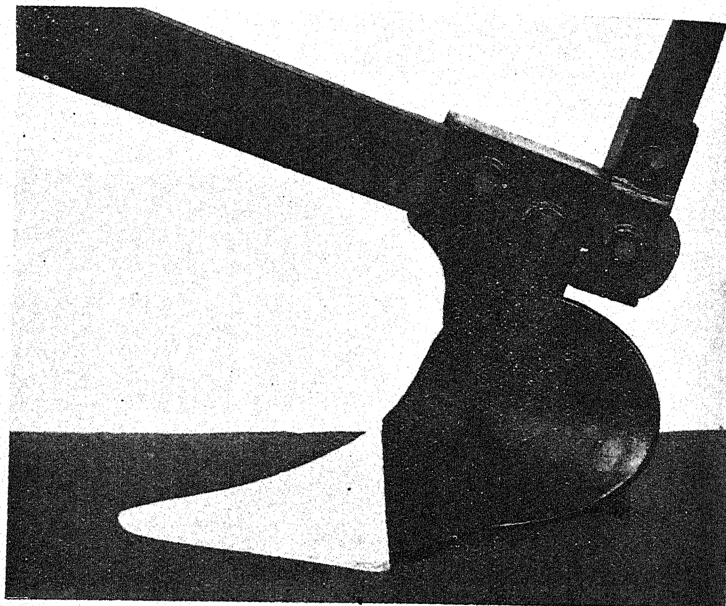
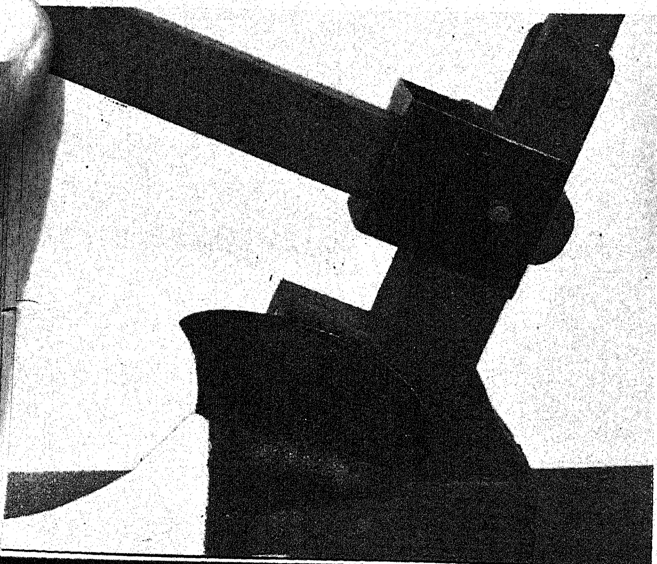


PLATE 87



Dacca wooden plough

This plough is made of wood and iron and costs only Rs. 6-8. Total weight $13\frac{1}{2}$ seers. This has been designed so that in time, after the public have got accustomed to its use, it can be made by the village carpenter and blacksmith with local timber and material for less than Rs. 6-8. It turns over the soil perfectly well and is suitable for use in any soil after a shower of rain. The draft of this plough is very low.

All the three ploughs do about four times the work of a *desi* plough.

Agricultural Engineer, Bengal

What the Scientists are doing

ROOT-ROT OF COTTON

THE Indian Central Cotton Committee has been financing two schemes for the study of the root-rot disease of cotton, one in Baroda State and the other in the Punjab, where the annual damage caused by this disease to the cotton crop is estimated to be very high. In the former place it is confined to the Gorat soil, while it is particularly serious in the canal-irrigated areas in the latter. The Baroda scheme was recently extended for another period of five years and the Punjab scheme terminated by the end of February 1942.

Symptoms of the disease

Plants affected by root-rot show signs of sudden wilting, the branches and leaves drooping from top to bottom. Perfectly healthy plants are killed outright within a day. The suddenness of wilting, destruction of the major portion of the roots, yellowing of inner wood and shredding of the root bark are common symptoms of the disease. Usually when a plant wilts, it seldom recovers. In the Punjab, cottons are normally sown in May and the disease makes its appearance in June. When the plants are about six weeks old, the attack continues to be vigorous throughout July, gradually declines in August and falls almost to zero by the end of September. In Baroda, it is at its maximum during the flowering and boll developing stages of the plant. The main causal organism responsible for the disease in the Punjab as well as Baroda is the fungus *Macrophomina phaseoli*. In the Punjab another fungus, *Corticium solani*, is also found parasitizing the roots, but is not so common as the other. It is established that the parasitic activity of *C. solani* tends to increase when acting in combination with *M. phaseoli*. In Baroda the eel-worms were found associated with fungus-affected roots but their occurrence with the fungus appeared to be accidental, as they do not produce root-rot but do their own type of damage. In both the places high soil moisture along with high temperature definitely increases the mortality of plants.

The evidence of periodicity in the parasitic activity of the causal fungi has been correlated in the Punjab with the time of sowing, showing thereby that the attack of the disease may be evaded by skipping over the period of maximum activity of the causal fungi, i.e. by sowing cotton very early in the first week of April or the end of June. Both *desi* and American cottons when sown late and planted closely gave significantly higher yields than the normal May sown cottons. American cottons when sown early in April gave lower yields. The bolls in these sowings opened badly. *Desi* cottons when sown in the first week of April gave, on the other hand, significantly higher yields than the May sown crop. In Baroda under rain-fed conditions where the practice is to sow the seed before the monsoon breaks, it is not considered feasible to attempt any change of sowing date.

Methods of control

Side by side with the investigation of factors influencing the incidence of the disease, attempts were made to devise measures to control it. The researches at the two centres have crystallized, in so far as these measures are concerned, into definite lines, the Baroda scheme concentrating on breeding disease-resistant cottons and the Punjab scheme focussing attention on the agronomic methods of control.

In the Punjab, a fodder pulse crop is usually grown with cotton. The experiments to test the effect of intercropping cotton with *jowar* and *moth*, as a measure of control against the disease, indicated that in the case of *jowar* the extent of reduction of the disease varied with the period of retention of *jowar* plants in the field, the least mortality being recorded in plots where the removal was effected by 16 August, whilst the removal of *moth* as early as 1 August reduced the mortality to

an appreciable degree. Further trials of this control measure are being conducted on a large scale before advocating its adoption by the cultivators. As regards varietal susceptibility, it was noted that all types—foreign and local—succumbed to the disease under Punjab conditions and showed a high rate of mortality. None of the progenies of plants selected showed any marked resistance to the disease.

In Baroda, the testing for resistance of a large number of varieties, both imported and indigenous, showed that the bulk cotton samples obtained from the village of Karkhadi were the only promising material that was resistant to root-rot disease under field conditions. Selection from Karkhadi bulk of types, which combined resistance with desirable economic characters, gave 12 families which, when tested for yield and resistance, revealed no significant differences: their average mortality in these experiments in 1940-41 was 23 per cent against 96 per cent suffered by Broach 9. The Karkhadi material is, however, very poor in spinning performance, spinning only 10's on an average against 24's of the local Broach 9. Karkhadi is, however, superior to Broach 9 in ginning outturn, and on a par with it in respect of yield and staple length. Further attempts at selection in Karkhadi are concentrated on the isolation of highly resistant strains which might be useful as parents in hybridization with other quality cottons. Work in this direction was started in 1939-40, and during the extension period it is proposed to continue this work and ultimately to cross the selections obtained with quality *arboreums* and *herbaceums*.

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FOR I. C. S. PROBATIONERS

In accordance with the general plan of providing the I. C. S. probationers under training at Dehra Dun with information in regard to the rural economics of this country, Mr F. Ware, C.I.E., F.R.C.V.S., I.V.S., Animal Husbandry Commissioner with the Government of India, delivered two lectures to them on animal husbandry matters on 24 and 25 March 1942. The first lecture dealt with general considerations and in particular an attempt was made to explain what is covered by the term Animal Husbandry, and in the second lecture reference was made to the manner in which some of our more important breeds of cattle and sheep have been developed, rational methods of feeding, and the prevention of the more important contagious diseases. Considerable interest was shown by the probationers in the subject and a useful discussion took place at the end of each lecture.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q : When were fig plants first cultivated on Indian soil ?

A : The history of fruit-growing in India is an interesting but obscure subject and investigators have found it extremely difficult to get authentic information on the early history. Attempts to enlist the aid of scholars, especially those who can read Sanskrit, have largely failed.

Roxburgh listed 55 species of *Ficus* as growing in India, and many of these are indigenous. In the Sanskrit literature, no reference to the fig dates from before Christ. The *Matsya Purana* mentions quite a number of fruits, including one translated 'fig', but this may be *Ficus glomerata* which species is mentioned by the Chinese Buddhist pilgrim, Yuan Chwang (the name is variously spelled), who was in India from A.D. 629 to 645. This species is also mentioned in the *Sukra Niti*, written in the 16th century. As *F. glomerata* produces edible fruit, it may have been listed as a fig, and it is quite uncertain when the common fig, *F. carica*, entered India. It is considered native of the region west of India, including southern Arabia, and may well have reached India at a very early date.

It seems highly probable that the type of fig now grown most commonly in this country is a hybrid between *F. carica* and some other species. As far as is known, the caprifig (the only type of *F. carica* producing pollen) does not exist in India. Any seedlings, therefore, would have one parent of another species. The fact that the commonly grown fig has leaves that are practically entire, instead of the more or less deeply incised leaves that are typical of many European varieties, supports this theory. It also seems to be the case that introduced varieties show less vigour here than the common type.

If this is the case, it would be correct to state that the fig as it is now grown in India is partially indigenous to the country.

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Q : 1. What kind of cows in Agra and Oudh give the best milk yield and from where are they available, particularly in the United Provinces ?

2. What and how much food, i.e. fodder and grain, do you suggest for milch cows to get the best quantity and quality of milk ?

3. What is the most economic fodder for such cattle, keeping in view question No. 2 ?

4. Do you suggest any method by which milk can be sent to a great distance, where it cannot ordinarily be sent fresh ?

5. Please suggest any other ways and means to increase the quantity and quality of milk generally.

A : 1. The best type of cows for milk production for your part of the country would be either Sahiwal or Hariana. Red Sindhi and Tharparkar would be better milk producers than the Hariana, but they would be costly to obtain from Sind. The Sahiwal is perhaps the best milk-yielding breed in the country today, but its male progeny is not very suitable for work either on the road or in the field. Sahiwals can be obtained from the Montgomery district, Hariana from Rohtak, Karnal and other places, Red Sindhi and Tharparkar from Karachi and Hyderabad in Sind. I am afraid there is no place in the United Provinces from where good animals of these breeds can be got easily.

2. For obtaining the most economical results from the dairy cow she must be fed on what

is known as balanced ration. This ration should consist partly of bulky fodder and partly of concentrates. The quantity of bulky fodder will depend on the kind of fodder available, but as a general rule where green fodder is available it can be fed to the extent of 40 to 50 lb. per animal. As regards the concentrates, the quantity to be fed will depend on the milk yield of the cow. These concentrates are prepared in the form of a mixture consisting of oilcakes, wheat bran, *chuni* and some type of husk like gram husk. The exact proportion of these ingredients will depend on the kind of foodstuffs available and if you will say what foodstuffs are easily available in your part of the country, advice can be given on a suitable mixture. Roughly speaking such a concentrate mixture is fed at the rate of 3 lb. for the first 5 lb. of milk yielded by the cow and 1 lb. of mixture for every additional 3 lb. of milk given by the animal.

3. It is difficult to advise without knowing the kind of fodders available in your part of the country as to the one which will be most economical to feed to the cattle. All green fodders in the form of perennial grasses like Guinea and Napier, cultivated crops like *jowar* or maize, and *kadbis* of either *jowar* or *bajra* have more or less the same feeding value. The most economical fodder would, therefore, be what is most easily available or can be cultivated in that particular part of the district.

4. If it is the intention to send milk as milk for people living at a great distance from the centre of production, the milk will have to be pasteurized. Otherwise it can be converted into products like butter, cheese, and ghee for long-distance transport.

5. The soundest method of improving the milk yield of either an individual cow or a dairy herd is to adopt a proper breeding and feeding system.

What's doing in All-India

BENGAL

By Nirmal Deb, L.Ag.
Propaganda Officer, Department of Agriculture, Bengal

BENGAL is not lagging behind other provinces in the matter of increased food production. Early in March a Food Production Committee, consisting of representative officials and non-officials, was set up by the Government for chalking out the line of action and advising on the steps to be taken for making the drive comprehensive and effective. The Assistant Director of Rural Reconstruction, a former senior officer of the Agricultural Department, has been appointed Special Officer, Food Production, for coordination of propaganda in the province.

Maximum production

The present 'Grow More Food' campaign is, for obvious reasons, no long-term crop-planning involving costly land reclamation or irrigation projects or other elaborate measures for the introduction of scientific cultivation, but a short-range programme with the object of maximizing the production of the most important food-crops to meet the present emergency. Naturally a short-range campaign like this in which there is no time to be lost resolves itself into two aspects, viz. (i) propaganda and (ii) organization. Intensive propaganda, through attractive and illuminating pictorial and slogan posters and also through radio talks, lectures to agriculturists and messages through the press, is being done to bring home to the people the present emergency and make them alive to their responsibility to themselves and to the country at large. The organization side of the campaign is designed simultaneously to promote increased production of the essential food-crops.

Being the staple food of Bengal, rice is by far the most important crop. Anomalous though it may seem, it is a fact that though this crop normally covers about 90 per cent of the cultivated area, its production in normal times fell short of requirements. Bengal was a deficit province in respect of rice. The deficit, amounting to about 64,000 tons, i.e. 17½ lakh maunds, had to be made up by import from outside, principally from Burma. Fortunately enough, in 1941-42, the acreage under rice increased by about 25 lakhs as a result of the Government's compulsory restriction of jute cultivation. The season also was generally favourable, and a very good crop was harvested. This increased acreage and favourable season resulted in a large surplus. Thus the position of Bengal today in respect of rice is much stronger than it has ever been in the past.

Help from Bengal

Bengal can come to the rescue of the deficit provinces of India to the extent of over 300 lakh maunds. With a view to maintaining this production and also to bringing about regional self-sufficiency in consideration of the increasing uncertainty of transport facilities between different parts of the province, the greatest attention is naturally being paid in Bengal to paddy. A scheme for distribution of the departmental varieties of paddy seeds has accordingly been drawn up and is being carried out. According to the scheme 500,000 acres of paddy—125,000 acres in each of the four representative tracts, embracing 22 major districts—will be covered with the departmental paddies suited to the different tracts. The 250,000 md. of seed required to cover the area is being purchased from approved growers at Government cost and distributed among cultivators on *sawai* basis by which 1¼ md. of paddy will be returned

by the cultivators after harvest for every maund advanced to them in the sowing season. Owing to the minimum increased yield of 3 md. per acre on account of superiority of the departmental strains, it can be reasonably hoped that the food-supply will increase next year by at least 15 lakh maunds of rice.

This paddy seed distribution scheme, including the contingent charges and cost of supervision by temporary staff, is estimated to cost Rs. 16,12,500. The amount has already been allotted and the scheme put into force in April. It may be mentioned here that though jute cultivation for this year had been restricted to 10 annas of the 1940 crop and licences already issued accordingly before the campaign was planned, orders have since been issued for propaganda far and wide to persuade the cultivators to sow no more than 8 annas of the 1940 crop, substituting the area thus released with paddy.

Shortage of edible oils

In respect of mustard (the source of the most important food-oil used in this province) and lentil and gram, the commonly-used pulses, the situation is more depressing. They constitute the other essential foodstuffs, but Bengal is till now hopelessly dependent on other provinces for supplies. Though no accurate statistics are available, it seems that Bengal is deficient of about 49½ lakh maunds of mustard oil, which is about 73 per cent of her consumption, and of about 506½ lakh maunds or 75 per cent of pulses. With the object of making up this deficiency a second scheme for the extension of the crops has been drawn up and sanctioned. The scheme includes the extension of mustard over 25,000 acres, lentil over 20,000 acres and gram over 15,000 acres, thus increasing the cultivation of these essential food crops by 60,000 acres. Seeds of the departmental strains of these crops, viz. *tori* No. 7 and *rai* No. 5 mustards, lentil No. 5 and gram No. S4, raised by approved growers, are already being purchased at Government cost and will be distributed in due time on the *sawai* system. This scheme, including the contingent charges and pay of the supervising staff, has been estimated to cost Rs. 1,58,906, which has already been allotted by the Government.

Propaganda has been started for the preparation of compost from all sorts of vegetable refuse and also from water-hyacinth and its application for the enrichment of the soil in humus which is the greatest deficiency of the soil of the province.

With a view to relieving the strain on the available food supply in the province, propaganda is being done to persuade private householders to put all available homestead land under seasonal vegetables and quick-yielding fruits like bananas, papayas, pineapples which can be grown easily and which supply wholesome and nourishing food for domestic consumption.

The question of fodder crops also is not being overlooked. Vigorous propaganda has already started to stimulate cultivation of such crops, particularly of Napier grass, on a more extensive scale.

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.)
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VERY acute wheat shortage in the province made it necessary for the Government to take extraordinary measures. Two restrictions on the normal movement of wheat and wheat products were imposed. The first was an order stopping all exports from the province and from one district to another except under permits issued by the Provincial Price Controller. Secondly, District Magistrates were authorized to requisition available stocks of wheat and other cereal grains, releasing them only under

orders from the provincial Government or for immediate local consumption. This shortage further necessitated the use of coarser grains and rice on a much larger scale than usual, and the mixing of barley with wheat up to a limit of 40 per cent.

Now that the new crop is about to come to the market, the Punjab Government has decided to remove the ban on the movement of wheat from one district to another. Further no wheat supplies will ordinarily be requisitioned by the District Magistrates. With a view, however, to having some supplies in hand to meet any emergency, should there be any serious local shortage in the event of maldistribution, the Punjab Government has decided to buy at a guaranteed price sufficient stocks to last the entire urban population for a month. It is hoped this fact, apart from other considerations, will ensure a fair price to the growers when the new crop comes to the market.

Regarding external movement of wheat, the Punjab Government has decided on the figure of maximum exports that can be permitted with safety from the province after meeting local requirements.

It has further been decided in consultation with the Government of India to introduce a system of registration of dealers. Every wholesale dealer will have to register with the District Magistrate, who will give him a licence, without a fee, subject to the condition that he sends every month figures to the District Magistrate and the Price Controller showing arrivals, sales, exports and the total stocks in hand of wheat and wheat products. This will enable the Government to keep in touch with the distribution of these commodities throughout the year.

Increased food production

It is proposed to take the following steps in the Punjab during the current year in order to bring about an effective decrease in the area of short-staple cottons, the price of which has fallen to such a low level that their cultivation is no longer profitable.

In the colony districts which grow about 30 per cent of the total *desi* cotton grown in the province, a large-scale propaganda drive is being started for inducing the cultivators to substitute as much as they possibly can of the area under *desi* cotton, either with long-staple cottons where soil and other conditions permit, or failing that, with food grains. As a practical step towards this substitution the Agricultural Department has undertaken to provide cultivators with the requisite quantity of seed of various long-staple varieties. Similar steps are being taken in the districts of Lahore, Ferozepur and Amritsar which together grow upwards of 50 per cent of the whole *desi* cotton grown in the non-colony districts, though the conditions in them also were quite suitable for growing American cotton on a much greater scale than at present.

In the south-eastern districts which together have hitherto constituted the predominantly *desi* cotton growing tract of the province, cultivators with big holdings who have adequate irrigation facilities are being induced to grow long-staple in place of short-staple cotton as far as possible, while small areas of American cotton are also being substituted on holdings of small cultivators.

The part of the area at present under *desi* cotton on which American cotton cannot be profitably grown is being replaced by food crops. The cultivators of such lands are being induced to grow food crops such as maize in the central and *bajra* in the south-eastern districts. To make these recommendations more effective the Punjab Provincial Cotton Committee has suggested that the Government should fix immediately a minimum price for each food crop so that there is enough inducement for the cultivators to take up cultivation of these crops in preference to short-staple cottons.

Other measures suggested include the use of Government waste lands for growing grain crops, more extensive use of oil-cake for manuring crops like maize, reduction of land revenue for crops like maize and *bajra* and increasing it for cotton, substitution of barley for *toria*, increase in the acreage under vegetables like sweet potatoes and carrots.

To consider ways and means of increasing the production of foodstuffs a conference was held at the residence of the Hon'ble Sardar

Dasaunda Singh, Minister for Development. The Hon'ble Mr N. R. Sarker, Member of the Viceroy's Executive Council, presided. Representatives of Kashmir, Patiala, Nabha, Bahawalpur, Jind, Faridkot, Kapurthala and Malerkotla states also attended.

The representatives of the states present expressed their readiness to join whole-heartedly in the 'Grow More Food' campaign. The Punjab is a surplus province but further efforts will now be made to increase the surplus of food to the utmost extent possible.

Rust-resistant wheat

Due to unusually cloudy weather and frequent rains which resulted in high humidity, particularly in February, the attack of yellow rust was encouraged and assumed epidemic proportions. Unsatisfactory as it was, it afforded an opportunity for judging the resistance of various wheat varieties to this disease. As a result of these studies, four yellow-rust-resistant cultures and two single plant cultures derived from C228, itself a yellow-rust-resistant sort, were found to be absolutely free from the attack of yellow rust.

Studies on the standardization of *chapati*-making technique have shown that for determining the sugar content of various wheats the alcoholic-extraction method is to be preferred to the aqueous-extraction method as the latter gives erroneously higher values on account of hydrolysis of some soluble starch originally present in the sample. Sugar contents of 16 wheats were tested with the result that P111, Pb. 17, 9D, C228 and C591 topped the list, in the order given.

Rice

The rice grains obtained from some fine varieties grown in the Punjab during the last (*kharif* 1941) harvest have been found to be rather poorly filled and to show an unusual amount of chalkiness or abdominal whiteness. On account of these defects they are not likely to stand long storage well, and consumers would do well not to store them in large quantities for long periods in order to obtain 'old' rice, which is believed to possess a much better cooking quality than the freshly milled rice.

It has been found that the seedlings obtained from nurseries seeded at the rate of 8 per *marla* (1/160 acre) give, when planted out in the fields, higher yields of paddy (by about 2 md. per acre) as compared to heavier seed-rates (16-24 *chataks* per *marla*) commonly used.

ASSAM

By S. Chakrabarti, B.A. (Hons.)
Assistant, Office of the Director of Agriculture, Assam

AN intensive drive for increased food production has been undertaken by the Department of Agriculture in Assam. The campaign in Assam began with potatoes in October, 1941, and the area under the summer potato crop in the hills is expected to show an increase of 30 per cent over the usual cropped area, yielding an additional outturn of 22,725 tons of potatoes.

Rice campaign

The campaign has recently been extended to cover rice, of which the annual outturn in normal years just about meets the province's annual requirements, without leaving any surplus for lean years. Vigorous propaganda is being conducted for extending the double-cropping of paddy and for inducing people to put as much land under it as possible, reducing the area of fallow land to a minimum; and large quantities of seeds are being supplied to the cultivators for facilitating the cultivation of more land than has ever been attempted. The Department is supplying heavy-yielding seeds of improved strains of paddy to its maximum capacity,

but as the huge demand for seeds can only be partially met this way, arrangements have also been made for supplying ordinary seeds either against cash or on loan. Use of more manure and better cultural practices is also being urged for increasing yield. For the extension of the double-cropping of rice, large-scale sowing of *aus* paddy (autumn rice) is under way, to be followed by the transplanted winter paddy crop. The campaign is being conducted in right earnest and the Agricultural Department is being greatly helped in this work by the Revenue staff and non-official organizations.

The tea planters of Assam have extended the area under rice in the estates and introduced improved varieties of paddy. Some hundreds of tea estates have been visited by the Economic Botanist and the Deputy Directors of Agriculture, according to whose recommendation more than 2,500 md. of high-yielding seeds are being supplied to the tea estates.

The first reports now coming in regarding *aus* paddy indicate that we may hope for an increase of 25 per cent over the normal cropped area, which should produce an additional outturn of 73,000 tons of paddy.

Dig for victory

As regards pulses, our position is not satisfactory as Assam imports pulses of the value of Rs. 45 lakhs annually from other provinces. The biggest drive of all will, therefore, be that for the increase of *rabi* food crops, which in our case mean *matikalai* or *urid*, *masuri*, *khesari* and *arhar*; and this drive will be taken up as soon as the rice crop is well under way. Seeds are now being collected in anticipation of shortage at the sowing time.

Steps are also being taken to ensure increased production of maize and fresh vegetables during the current summer months in the hill areas of Shillong and in the Naga hills on the line of communication from Assam to Burma. Necessary propaganda by means of 'Dig for Victory' pamphlets, etc. backed by supply of seeds, is in full swing.

Rice is the staple crop of Assam, covering as it does 5,425,943 acres of land out of a total cultivated area of 7,675,745 acres (1940-41 figures). Agricultural research in Assam has, therefore, been confined to paddy and directed to the introduction and selection of superior types, and production of improved types by hybridization. As a result of investigations carried out at the Paddy Experiment Stations at Karimganj and Titabar, 38 improved strains of *aus* (autumn rice) and *sail* (transplanted winter rice) paddy, suited to the different localities of the province, have been evolved, which, on an average, are giving an increased yield of 6 md. of paddy per acre over the local. Attention has also been devoted to the improvement of cultural practices. As a result high yields, comparable with those obtained in Japan and Italy, have been obtained at the Government Farms. It has been observed that a 50 per cent increase in outturn can be secured, without any appreciable increase in cost, by growing pure seeds of these improved strains and by adopting better cultural methods.

Flood-resistant rice

There are two other important kinds of paddy—the long-stemmed *amon* (deep-water winter rice) and *boro* (spring rice). *Amon* is the main crop of the low-lying areas of the Sylhet district. It is also grown in small patches in Barpeta, Dhubri, Sibsagar and Lakhimpur. The actual area under this crop is not known as no separate statistics are recorded, but it can safely be assumed that at least 600,000 acres are cultivated with this crop in Sylhet alone. Although *amon* is normally very prolific and quick-growing, the uncertain nature of floods makes its success always precarious. Very abrupt rises of flood water often result in the almost total destruction of this crop. Researches have, therefore, been conducted since 1934 at the Habiganj Paddy Experiment Station, with financial help from the Imperial Council of Agricultural Research, for the evolution of flood-resistant strains of *amon*; and up to date three improved strains have been evolved. The first of these gives an average yield of 23 md. of paddy per acre and can grow in 5 to 7 ft. of water, the second can stand up to 10 ft. of water, giving an average acre-yield of 41 md. of paddy, while the third can

withstand up to 14 ft. of water, yielding 34 md. of paddy per acre on an average.

The spring paddy, *boro*, is also an important crop of the Surma valley, especially of Sylhet. As it is transplanted in winter and has to depend to a great extent on irrigation, it is usually grown on the margins of *beels* (natural depressions which retain water throughout the year), which are numerous in Sylhet. While *beels* supply most of the irrigation water for the crop, in some areas streams and rivers are also utilized. More recently, power-driven irrigation pumps have also been used by the Agricultural Department with success for growing this crop. *Boro*, however, suffers badly from drought and researches have, therefore, been conducted at the Habiganj Farm for the evolution of drought-resistant and drought-escaping varieties of this class of paddy; and up to date three improved strains have been evolved which give an average acre-yield of 23 to 36 md. of paddy.

Fodder research

Trials with practically every fodder crop known to grow in India have been conducted in Assam. The one fodder that stands out above all others in these trials is Napier grass, but it does not thrive in any but well cultivated and drained land. A large proportion of the waste land in Assam, where grasses can be grown, is, however, waterlogged or submerged. Another kind of waste land suitable for the purpose is known as *tillas* (hillocks). Assam, therefore, needs grasses which can grow in these two kinds of waste land more than good grasses like Napier. Another important fact, which emerged from the trials, is that most of the very valuable leguminous fodders of India, such as lucerne and berseem, do not grow in Assam owing to the acidic character of its soil; and Assam has, therefore, to be content with those grasses which can tolerate an acidic soil.

The *tillas* are usually covered with scrub jungle and *ageratum*. Little use is made of them except for collecting firewood. They could, however, be made to provide cheap fodder if they were planted with fodder trees and grasses. After trials, the Agricultural Department has selected three local grasses—*rema*, *tallia* and *dhus*—which do very well on *tillas*. The first two are perennials, which grow naturally to a height of 6 to 10 ft. in large clumps among trees and shrubs. As the stems of these grasses are woody and fibrous, only the top portion of the stems and the leaves are eaten by cattle. *Dhus* is found on the open slopes of the North Cachar hills and is known to the graziers as a good grass and eagerly sought after by them. It does not require manuring or cultivation of any sort. In addition to these grasses, the Department has also recommended 50 different kinds of trees—supplying plentiful edible leaves for use as fodder—which can be grown on the *tillas*.

Aquatic grasses

Thirty to forty per cent of Assam cattle are reared in localities surrounded by partially submerged areas called *haors* and *beels*, where water stands throughout the year and which present a magnificant view of unbroken sheets of deep water for miles when the monsoon is in full swing. These cattle are fed with grasses and reeds that grow in the *haors* and *beels*; but the spread of water hyacinth has reduced the area under these fodders and the cattle suffer in consequence. These areas can, however, be made to provide an immense supply of green fodder at little trouble and expense if some care is taken to protect the local grasses. Fodder supply in these places can be assured by urging that wherever clearing of water-hyacinth is undertaken, it should be followed by the planting of roots and seeds of local aquatic grasses, of which the Department has selected as many as 11 good varieties. Of these, *doob* is the most common and valuable perennial, which remains alive under water of any depth. During the early monsoon the grass is collected by pulling from shallow water, while in the late monsoon it is collected by men diving under water. This grass keeps sweet in wet condition for many weeks. During the dry season, when water recedes, it sprouts and grows luxuriantly, providing good grazing and cuttings. *Dudh-chaulia* is another good perennial of the *haors*. Like *doob*, it can remain under water and is utilized as a monsoon cut-fodder. It is collected in the same way as

doob. *Keja* is another perennial fodder, which grows from 15 to 20 ft. high in deep water. It can also grow in shallow water. There is also a good exotic, viz. Para or Mauritius grass, introduced by the Agricultural Department, which promises to be of great value for the low-lying areas. It is a perennial and grows under all conditions from drained flat land to a depth of 10 to 15 ft. of water. It has none of the drawbacks which are found in some of the local aquatic grasses, such as sharp edges to leaves and a tendency to cause purging. Under dry or semi-wet conditions it spreads by long runners which form a mat over the ground from which stalks and leaves grow upwards to a height of 3 to 5 ft. Under water the runners grow up with the rising water and a mass of stalks and leaves float on the surface. It has an additional advantage over other aquatic grasses in that in wet land it gives heavy cuttings in the dry season.

HYDERABAD

By Mirza Mohiuddin Baig, B.A.

Personal Assistant, Director of Agricultural Propaganda, Hyderabad-Deccan

The tenth Horticultural and Poultry Show was held this year at Hyderabad from 15 to 17 January. In the horticultural section there were 145 entries and 776 exhibits as against 139 entries and 957 exhibits last year. Though the number of exhibits was small, the quality of all the exhibits was excellent.

In the poultry section there were 117 entries and the number of birds actually exhibited was 522 as against 136 entries and 644 birds last year. The birds were of pure breed, true to type and were nicely prepared for the show.

The total number of exhibits in both the horticultural and poultry sections was much less than that of the previous year, because of the difficulty of transportation owing to petrol rationing, and because of scanty rainfall and unfavourable weather conditions. The decrease in poultry exhibits was due mainly to outbreaks of diseases and epidemics and many of the poultry-keepers disposed of their stock due to the increase in the prices of poultry feeds.

Horticultural section

In the horticultural section, exhibits raised in the state were allowed to compete except for those classes which were exclusively meant for imported exhibits, e.g. fruits, vegetables and ornamental plants. This year there was only one entry in the class of imported vegetables, while there was no entry in the classes of imported fruits and imported ornamental plants. That gives a little idea of the self-supporting position of the state. The remaining 15 classes consisted of foliage plants, annuals and perennials in pots, cut-flowers, collections of ornamental plants and vegetables from private individuals and Government institutions, collections of fruits and vegetables, practical competition, gardens enlisted for garden competition and judged twice, e.g. once in the rainy season and once in the winter.

There were 326 exhibits in the vegetable class, 159 in the fruits class and 137 in the cut-flowers class as against 346, 290 and 158 exhibits respectively last year. As mentioned previously, this gives a general idea of the interest of the public in spite of the adverse conditions prevailing in the whole country. In the horticultural section 7 cups, 1 vase, 96 certificates and Rs. 407 in cash were distributed as prizes to the exhibitors, thus making a total of 511 prizes.

Poultry section

The poultry section was open to the birds reared and bred in Hyderabad only, but one class was also provided for imported birds. Two classes were reserved for White Leghorns and Rhode Island Reds reared by *bona fide*

cultivators. The remaining 19 classes consisted of *aseels* (Indian game fowl), White Leghorn, Rhode Island Reds, Black Minorca, Light Sussex, Australorps, Orpington, Barred Plymouth Rock, all other light breeds like Polish, Bantams, Silkies, etc. ducks, turkeys, guinea fowls, birds belonging to Government and municipal institutions and white and tinted eggs of fowls. In all there were 522 birds and 13 groups of both white and tinted eggs, each group consisting of 6 eggs.

The strongest class exhibited was the *aseels* consisting of 99 birds. The next class was of White Leghorns consisting of 84 birds. Four cups, 79 certificates and Rs. 353 in cash were awarded.

Livestock census

Information is now available of the results of the quinquennial livestock census which was held in the state last year. According to it, the total of animals of all types has been reckoned at 22,544,279, or slightly less than the total at the previous census when it was 22,578,315. It is pointed out, however, that the seeming fall in the number of livestock, as compared with the figure five years ago, is actually attributable to increasing accuracy in the compilation of these statistics rather than to any actual fall in numbers.

Approximately 55 per cent of the total comprises cattle, both milch and draught, the actual numbers being 9,527,382 cows and bulls and 3,032,421 buffaloes. The number of milch cattle is around 3,900,000, with cows enjoying a preponderance of two to one over buffaloes. On the other hand, the figure of draught cattle has been estimated at 4,114,687, of which only about 10 per cent are buffaloes.

Other animals included in the census, namely horses, ponies, camels, sheep, goats, mules and donkeys approximate some ten millions, distributed more or less evenly over the state. Horses, ponies, sheep and goats form the bulk of this number.

Nizamsagar water storage

A committee appointed to investigate all the possibilities of the development of combined hydro-electric and irrigation schemes has almost completed its labours, and among its proposals is a hydro-electric scheme for Nizamsagar. It has, in addition, recommended the purchase of a generating set of 7,500 k.w. capacity for the Hyderabad thermal power station and also a diesel or steam-generating plant of about 1,500 k.w. capacity as an emergency measure, and the installation of two new boilers. With this additional equipment, the maximum output of the Hyderabad thermal power station is expected to reach the figure of 47 million units, but the average during the next five years is not expected to exceed 33 million units per annum. To fill this gap between supply and demand, it is proposed to generate hydro-electric power at Nizamsagar and to arrange for its overhead transmission to Hyderabad. Thus a scheme involving an estimated expenditure of Rs. 50 lakhs has been drawn up for utilizing the water at Nizamsagar (the biggest dam in the state) for generating hydro-electric power. The step is being taken to stimulate industrial expansion by supplying cheap power and also to meet ever-growing consumption.

Vocational education

H. E. H. the Nizam's Government has under consideration a tentative programme for the expansion of the activities of the Department of Technical and Vocational Education and allied institutions.

The programme envisages the establishment of two agricultural high schools, five post-primary industrial schools for boys and three for girls and a psychological institute. One of the two agricultural schools will be opened in Telingana and the other in Marhatwada, the most likely stations being Aurangabad and Warangal. These schools will aim at turning out men capable of managing large and small agricultural estates and industries subsidiary to agriculture such as poultry- and dairy-farming, and also teachers required by the Education Department to give agricultural bias to instruction in rural schools.

The psychological institute will be managed by the Employment Bureau and is intended to obviate the tragedy resulting from wrong choice of profession by guiding young men in the adoption of suitable courses.

The programme, if approved by Government,

is estimated to entail a non-recurring expenditure of over Rs. 17 lakhs and a recurring annual expenditure of nearly Rs. 475 lakhs. This expenditure will be spread over a number of years and, for the present, the Government has sanctioned an additional annual recurring expenditure of Rs. 5 lakhs and a non-recurring expenditure of Rs. 9 lakhs.

New Department of Fisheries

A new department has been formed in the first instance for three years under an officer designated Superintendent of Fisheries, who recently took special training at Madras. An amount of Rs. 17,000 recurring and Rs. 6,014 non-recurring has been sanctioned. The Department will initiate research into various matters connected with fish and the manner of their profitable breeding. A careful survey of rivers, lakes and tanks has already been started to ascertain the number and extent of the indigenous varieties of edible fish so that only the best species may be reared. It is also intended to import fish not found in Hyderabad from the Punjab, the United Provinces, Madras and Bengal for breeding purposes. Side by side, the Department is considering plans for the cheap and speedy transport of fresh fish to centres of consumption.

Scarcity conditions

Owing to the erratic nature of the monsoon and the consequent deficient rainfall in many areas, particularly in the Telingana tract, scarcity conditions were apprehended. To meet the situation, Government decided to remit assessment for the current year under wells in the districts of Nalgonda, Warangal, Raichur, Osmanabad and Gulberga if fodder crops (*bajra*, *makkai* or *jowar*) are grown. Another concession given was that fodder and grain crops may be grown in the *abi ayacut*[1] under light irrigation under all Government sources, the assessement to be made at the rate of $1\frac{1}{2}$ times the maximum dry rate of the village. Furthermore, every facility was given to cultivators for irrigating fodder crops from rivers like the Krishna, the Musi and the Dindi, the land so irrigated to be assessed at only the maximum dry rate of the village.

It was also decided that free grazing should be allowed in the open forest areas except in those which have been demarcated for inclusion in the reserve forest areas, but even in reserve areas facilities for grazing are being allowed if they are not closed to grazing and persons are being allowed to carry headloads of grass free of charge.

Deficiency diseases

Diet surveys have been carried out by the Public Health Department in some rural tracts in Medak district. The survey embraced a fairly wide sphere, including 139 families drawn from small cultivators, tradesmen, agricultural labourers and depressed classes. Examination was also made of 2,400 boys and 227 girls from primary schools and a number of stray children.

The survey revealed that Bitots spots, xerophthalmia, angular stomatitis and glossitis are the common deficiency diseases in this area. Cases of pellagra were met with in Siddipet taluka, where Indian maize forms the bulk of the villagers' diet. Some old cases of lathyrism were noticed in two villages of Jogipet taluka, where it seems to have first appeared about 20 years ago during severe famine. The villagers were forced to eat the then only available food, *khesari dhal*, which might have been consumed with the contaminating weed, *vicia sativa*. No cases have occurred since, as villagers have now taken up eating Italian millet (*kangani*) or *korralu* in preference to *khesari dhal*.

Villagers have been advised to add a little more *jowar* or *ragi* to their present intake of home-pounded rice in order to enhance the nutritive value of their diet. Parboiling of rice, which retains its nutritive value and is less affected by milling, washing and cooking, is also recommended. In addition to these, villagers have been asked to supplement their main rice diet with pulses and leafy vegetables in good quantities.

[1] Land fixed for paddy cultivation during the monsoon.

BARODA

By R. Y. Pawar

Marketing Officer, Baroda State, Baroda

BARODA is short of food supplies. Generally the total deficit in respect of food crops is estimated to be 90,800 tons. Of these, the wheat deficit is 13,100 tons, paddy 47,800, *jowar*, *bajra*, pulses, etc. 30,400 tons. The shortage of these foodstuffs can only be met by a changeover of land under non-food crops like cotton and tobacco to *jowar*, *bajra*, pulses and wheat.

Substitution

Assuming the area to be planted this year under normal conditions to be the same as the last season, to get an adequate supply of *jowar*, *bajra* and pulses, according to the soil, reductions of the cotton area have been proposed as follows:

District	Per cent	Acres
Navsari . . .	5	11,000
Baroda . . .	10-12	40,000 to 50,000
Mehsana . .	20	30,000
Amreli . . .	40	35,000

The area mentioned under Baroda district is exclusive of interline paddy: if in 70,000 acres wider rows in planting cotton are adopted, the result would be equivalent to 35,000 acres further cotton reduction.

The marketing of country tobacco is likely to be very sluggish. Possibly 20,000 acres in Baroda district will be transferred to food crops. A certain proportion of the area normally under this crop and under rape-seed in Mehsana district will also go under food. A great deal of this area is irrigated and will provide wheat. The unirrigated portion of the Petlad taluka of Baroda district and even some of the irrigated land will go to produce *bajra* with profitable results.

Paddy crop increase

The state is short of rice. This crop is restricted to what is known as *kyari* lands. It is not easy to convert land usually under an open crop like cotton, *bajra* or tobacco to paddy. Its expansion is limited to existing *kyari* lands. In Gandevi, Navsari, Palsana and Mangrol talukas of Navsari district, there is luckily rather less paddy land, and of 15,000 acres, possibly 7,000 acres will be provided with local seeds, thus producing 7,000 to 10,000 Bengal maunds. The Government has already sanctioned Rs. 80,000 for the purchase of paddy seeds (including transport charges, bagging, etc.). The other source of paddy is the extension of the common practice in Baroda district of growing a coarse, early, variety of paddy in between rows of cotton. By stimulating cotton planting 6 ft. apart, it would be possible to sow three lines and under average conditions, we might get 700 to 800 lb. paddy. Thus an extra 25,000 to 30,000 tons of rice can be secured. The Baroda Government has been requested to remit 2 annas in the rupee from land revenue of all cotton land in which paddy is drilled between the cotton on the ordinary spacing and 3 annas in the rupee where wider spacing is followed; and assuming that 22,000 acres of the total area of the district responds, the loss in revenue would be slightly less than Rs. 1,20,000, representing the Government contribution towards increased rice production.

Wheat crop increase

Practically 50 per cent of the ordinary tobacco area that grows under wells will, with advantage, pass from tobacco to wheat in Petlad and Bhadran talukas of Baroda district. Here is a possibility of 10,000 acres. But wheat seed will have to be distributed to the cultivators on loan and recovered at harvest on *sawai*. One of the chief difficulties in this crop, this year, will be the price of wheat at the sowing time. This can be got over by providing seed and recovering it in the harvest crop. The *sawai* charges would be the state insurance. If there is rust, the Government will write off the *sawai*.

There is also an opening for increased wheat in Mehsana district, in place of rape-seed, irrigated tobacco and even that part of cotton grown on irrigated land. There is a clear

possibility of another 12,000 acres of wheat in this district and possibly 1,800 acres in Amreli district chiefly by cutting out short-staple cotton. Thus the production of wheat will be raised by 18,000 to 20,000 tons, on the 30,000 tons of this year's estimate. The state is also considering the matter of fixing the price of wheat in the harvest season.

Jowar-bajra and pulses

There will be a change over to *jowar* and *bajra* of about 1,30,000 acres; about 10,000 to 12,000 contributed from tobacco and the balance from cotton. Under average or satisfactory crop conditions, this may contribute a clear 30,000 tons with possibly a pulse mixture of 8,000 to 10,000 tons. It has been suggested that the state should create confidence by notifying a minimum price ranging between Re. 1-8 to Rs. 2 per Baroda maund for *bajra* and Re. 1-12 to Rs. 2-4 for *jowar* according to district.

Experimental work has shown that grain crop yields can be increased by 3 to 3½ Bengal maunds per *bigha* by the use of nitrogenous fertilizers and cake providing 10 to 12 lb. of nitrogen per acre. Fertilizers are almost out of the question now, but groundnut-cake applied at the rate of about 100 lb. per *bigha* at sowing is likely to have a similar effect. It is proposed to secure about 2,000 tons of powdered cake for about 44,000 *bighas*. The cost per *bigha* would be approximately Rs. 2. The state should provide the farmers with such fertilizing materials at Re. 1 or Rs. 1-4 per *bigha*. The capital cost would amount, at the present price of groundnut-cake, to Rs. 80 to 88,000 of which, on the above basis, the Government would find from Rs. 33 to 44,000 according to the difference between the cost price and the recovering price.

To induce the farmers to grow more food crops, viz. *jowar*, *bajra*, wheat, pulses, etc. leaflets on 'Sow Food Crops' have been printed and distributed in almost all villages. All taluka officers and touring officers have been specially instructed by the Government to suggest that cultivators reduce the area under money crops like cotton and tobacco and grow more food crops.

The Month's Clip

NUTRITION OF HIDES AND WOOL

THE growth of skin and its associated fibres, e.g. fur, wool and hair, is generally influenced by breeding, nutrition, climate, sex, age and management of animals—the first two factors being the most important. A brief study of the nature and structure of skin and wool explains the role of nutrition. Raw skin is composed of three layers, the first of which is the outermost hard protecting surface. The second layer is made of fibrous, elastic and muscular tissues and the superficial portion of this layer makes grain in leather. The third layer consisting of fatty tissues or flesh is lost together with the first layer in the process of tanning.

Pure wool, each fibre of which emerges from small cavities opening through the minute recesses in the skin tissue, is made of the protein substance known as keratin, which is essentially the same as the horny tissue found in hoof, nail and hair. The quality of these horny substances varies according to the structure in which they are found, the species, the colour of animals and other factors including nutrition.

The thickness and quality of hides and skins—and consequently of leather—depend on sex, age, breed, management and external influences or environment, and in sheep on the amount of wool yield of the skin, e.g. rams have thicker and firmer skins than ewes or wethers, and leather from young females is softer and lighter in weight. Heavily wooled sheep seem to have a thick spongy skin. Again, both cold and highly variable warm climates tend to produce thick skins. Nutrition or feeding has a great influence on thickness and quality of a hide or skin and this fact is borne out by a test carried out for a period lasting 112 days during which a batch of lambs was maintained on full feed and the other on half feed. The former at the close of the period doubled and the latter maintained their respective weights. The weight of the whole skin was 7·88 lb. for the full-fed lambs, whereas it was 3·72 lb. for the half-fed ones and the quality of leather of the former was superior.

Experimental evidence confirms the popular belief that nature of pasture and richness of soil greatly influence the quality and length of wool fibre. Any combination of feed that maintains sheep in good and vigorous condition tends to produce heavier fleeces than a poor ration which is responsible for lighter, shorter, finer, more crimpy wool and even leads to shed fleeces. It is generally accepted that a change in fleece weight, due to decrease in length and diameter of fibre, is usually associated with malnutrition and disease.

Much of the research on the relation of nutrition to wool production has been directed in recent years to the part played by sulphur in the growth of wool. Sulphur occurs in the cystine which constitutes approximately 13 per cent of keratin, whereas the proteins in animal and vegetable foods contain only 0·3 to 4 per cent of cystine. For many years cystine has been considered indispensable for the normal growth and health of sheep and it has been suggested that the capacity of any territory for carrying sheep is determined by the content of cystine in its pasture grasses.

Since wool is chiefly protein, the absorption and assimilation of protein is of great importance in wool production. Observations, however, show that the total protein requirements of sheep are not remarkably high in spite of the extra protein necessary for wool production and that protein in excess of requirements for maintenance and growth is without any effect on wool production. Addition of carbohydrates, e.g. maize, in food favourably influences wool production, although wool is entirely a protein structure. This is probably due to the fact that readily available carbohydrates in food can be used up for energy, leaving the protein to be more efficiently utilized for building and repair.

Experience in sheep husbandry has demonstrated that well-fed animals have a

good fleece and nutritional deficiencies interfere with its growth and quality. Mineral deficiencies have no direct effect on the wool yield and quality except that such conditions affect the general health and consequently decrease the intake of protein, carbohydrates and other nutritive elements. This is seen in cases of phosphorus deficiency. The effect of vitamins on the quality of wool and skin forms a new field for further investigation as laboratory animals and also pigs kept on rations deficient in vitamins of the B complex exhibit dryness of hide and loss of hair.—(Abstract) *Yearbook of Agriculture, 1939* (U. S. Department of Agriculture).

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THE MILKY WAY

THE barrels of most of our fountain pens and Eversharp pencils are made from milk plastics. The gloss of fine writing paper is entirely dependent upon milk for its finish. Milk is used in the preparation of plywood for airplanes to help men fly, and in chemical sprays to keep insects from flying. The Bureau of Standards gives casein glue a very high rating for use in such vital places as airplane construction, rafters of barns, etc.

It is reported that one of the ambassadors to England wore one of the 'milk suits' made from 85 quarts of chemically treated skim milk.

And 'the skin you love to touch' is that way in part because of a milk-base beauty cream, plus some fortification from dairy products she has consumed.

We don't know where the 'white magic' of milk will lead to, but Prof. G. H. Rollins of Virginia Polytechnic Institute says:

'Soon you may be crawling out from between blankets made of milk, spread on a bed which milk holds together, in a milk painted room. A rug of milk can protect your feet from the cold floor. You may turn on a faucet handle of milk to produce your morning shower, after which you may shave with a milk handle razor. You may comb your hair with a comb of milk, and brush it with a milk baked brush, and perhaps admire the results in a milk backed mirror.

'You may don your suit of warm milk wool, held in place by buttons of milk and matched to the "T" with your milk plaid necktie. Probably you will wish to turn the milk knob on your radio and press the milk button for the station you like to listen to. Your cream-drenched cereal may be served in a bowl of milk, and eaten with a milk spoon. After you have finished eating you can open the milk wrapper of a cigarette package for your smoke. Before leaving for the office you should kiss your wife on the forehead, made soft by milk base beauty culture. Last, but not least, do not forget to take out your milk-barrelled fountain pen and write a check on another sheet of milk surfaced paper to pay the bills.' (The milk bill.)

P. S. Wonder whether we might not make a cow stable of milk, milking machine of milk and possibly some milk milk-bottles. Whoa! Before we get involved in a tangle like the 'Which came first, the hen or the egg' controversy we'd better just stop here and close this article on 'white magic' with a toast to the producer of what started out as just the most nearly perfect food for mankind —which it still is, of course. So, here's to the cow! The Foster Mother of the World! —*The Goat World*, February 1942.

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COWS FOR BREEDING PURPOSES

THERE are few cattle farmers who do not make every effort to secure the best bulls for their herds.

The same attention is, however, not always bestowed upon the heifers and cows, in spite of the fact that much can be done in this respect to accelerate the improvement of the herd.

Although there has been a marked improvement in the average quality of our cattle as a result of the application of the Cattle Improvement Scheme, the rate of improvement will slow down once a certain stage has been reached, unless selection is applied also to the cows of our herds.

Even though the bulls used possess a sufficiently high degree of prepotency, which is often not the case, and even if the successive

bulls are selected with the greatest care, considerable variation will occur in the progeny if there is marked divergence among the cows. If the cows are also selected for the desired qualities, uniformity, as far as these characters are concerned, will be achieved much sooner.

It is not the contention of the writer that selection is an easy matter, nor the selection alone will solve all problems. It will, however, considerably expedite the process of improvement.

In regard to the principles of selection, it may be briefly stated that for breeding purposes those animals must be used which produced the largest progeny possessing the required characters.

There is no advantage in possessing a cow which, although she is a high milk-producer, calves irregularly, since she will be of value to the owner only during her lactation periods and is of little further use to the herd or the breed. The same is true of a cow which calves regularly but whose calves do not possess her good qualities. A cow may also calve regularly, but be unable to produce enough milk for her offspring. This is often the experience of beef breeders, who usually do not resort to hand rearing of calves.

The main requirements are, therefore, a knowledge of the individual cow and of her breed, her characters and history, and a clear conception, on the part of the breeder, of his purpose with his herd. The following should serve as a guide:

Select cows which began breeding at an early age and regularly produce calves of good quality, i.e. possessing the qualities desired in your herd. It stands to reason that these qualities will be evident only in the case of older animals. It is necessary to know the production record if only a few of the calves of a particular cow in order to be able to determine whether she produces good quality calves or not.

Only good quality cows which are themselves descendants of good quality cows, must be kept for breeding purposes. For this information, the stud book may be consulted, and if it has been kept properly, it will reveal whether the animal's ancestors for a few generations were bred for the desired qualities. If that is the case, there is an increased possibility of obtaining from a cow calves as good as she herself is, or even better, if she is mated with a suitable bull. However, full particulars are not available in the case of all animals. It is, for instance, impossible to say whether a heifer will be a satisfactory producer or not. In such cases animals must be selected merely because they are descendants of good animals. It may also be desirable to keep certain animals, even though absolutely no particulars are available. This frequently happens because most farmers do not keep records of parentage, milk production and breeding ability.

It may therefore be necessary to keep animals just because they are good producers or because they comply with certain conformation requirements. The influence of environment on production, breeding ability and other qualities must not be overlooked in the selection of cows. It would, for instance, not be fair to compare the milk production of well cared for cows with that of cows who have to fend for themselves on the veld. The amount of milk produced in relation to a fixed amount of feed must also be taken into consideration. Some animals produce much more economically than others.

How to effect improvements.—The cow's adaptability as well as her milk production must be taken into consideration. Animals bred for very high milk production, for example, should not be kept on poor grazing. Nor does it pay, on the other hand, to spend too much on feed for low-producing animals which can never earn their feed.

There are various aids to sound selection. The following are important:

1. The cow's milk record will be a guide to her production, both as regards quantity and quality.

2. A herd record will furnish information on such points as descent, with all particulars, age at which the cow first calved, number of calves and particulars.

3. Feed registers for individual cows will make possible a comparison between the cow's food consumption and her milk production with a view to determining her profitability.

4. The standards of perfection, where they have been compiled for a particular breed, will serve as a guide in judging a cow's conformation. The value of these standards will naturally depend upon whether conformation is correlated with any of the qualities desired by the breeders.

It is clear, therefore, that there are so many factors which exercise an influence on the profitable breeding of cattle that a thorough system of records of all particulars is essential for sound selection.—*Weekly Press Service, Department of Agriculture and Forestry, Pretoria.*

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BEESWAX IS VALUABLE

ALTHOUGH bees are kept primarily for the honey they will produce, the latter is by no means the only product of their labours. Pound for pound, beeswax is worth more than honey. Therefore beekeepers are well advised to save every particle produced, says C. B. Gooderham, Dominion Apiarist, Central Experimental Farm, Ottawa.

Every apiary will yield some wax, while in large commercial yards, run exclusively for extracted honey, the amount may reach several hundreds of pounds annually. Unfortunately in many apiaries, especially where only a few colonies are kept, pieces of comb taken from the hives during the summer months, broken or discarded combs are too often thrown aside and wasted when they could just as easily be placed in some receptacle and saved. If the beekeeper would only remember the price he has to pay for comb foundation he might perhaps be a little more careful of the wax produced by his own bees.

There is a certain amount of wax in every piece of comb and also in the cappings removed from the combs at extracting time, and while good combs are too valuable to melt down for the wax they may contain, there are always enough broken or discarded combs, brace or burr combs and cappings from which sufficient wax may be extracted to more than pay for the time and labour involved.

Wax as taken from the apiary always contains more or less impurities; therefore some means must be used to separate them. Two methods are in general use, one utilizes heat from the sun while the other requires artificial heat. The solar wax extractor is very useful for rendering small pieces of comb as they are taken from the hives during the summer-time, and it may also be used to extract the wax from small amounts of cappings. For large quantities, however, the most efficient method is first to melt the combs or cappings in boiling water and then to submit the molten mass to pressure. Presses, especially constructed for this purpose, are available from dealers in apiary supplies. A large proportion of the wax may be secured from the melting alone by allowing the melted mass to cool. The wax, being lighter than water, will rise to the surface and harden. A small percentage of the wax, however, will be held in the slum-gum beneath while some of the lighter impurities will be imbedded in the lower surface of the wax cake. Where this occurs the wax can be remelted and strained. There are a number of capping melters available which permit the melting down of all cappings as they are pared from the combs at extracting time, but all beekeepers do not have one and therefore must postpone this work until a later date.

Now that the bees are snugly packed away for the winter and the honey crop taken care of, the time is appropriate to recover the wax crop. Before melting down the cappings, however, carefully inspect your stock of drawn combs consigning all those that are broken or distorted to the melting pot with the cappings. By doing this, enough wax may be secured not only to supply the necessary foundation for next summer but also to trade in for other supplies. It is quite possible that the wax crop may be the difference between profit and loss on the season's operations.—*Press Note, Dominion Department of Agriculture, Canada.*

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THE LUSCIOUS TOMATO

REFERRING to foods, the sun-ripened tomato grown in this country is a general favourite among Canadians. Its greater popularity during the past few years, evidenced by the large increase in consumption of tomato products, is due in part to an awakened appreciation of the food value

of the tomato, as well as to the fact that its uses have become more varied.

The tomato season is now at its height, and while the hot weather continues tomatoes will be served for the most part in salads, and a little later hot tomato dishes will grace the supper table.

The spicy aroma of tomato relish from the kitchen is one of the first signs of early fall, and with the many recipes available housewives will be busy putting away the garden vegetables in the form of pickles and relishes for winter use.

Here are some of the favourite tomato recipes of the Consumer Section, Marketing Service, Dominion Department of Agriculture.

Oven Canned Tomatoes

Select firm tomatoes of medium or small size. Wash. Using wire basket or cheesecloth bag, immerse in boiling water 1 to 3 minutes or until skins will slip off easily. Plunge at once into cold water. Pack carefully in hot sterilized jars. Add 1 teaspoon salt for each quart jar. Fill jars with boiling water or boiling strained tomato juice to within $\frac{1}{2}$ in. of top. Run sterilized knife down side of jar several times to allow air bubbles to escape. Place new sterilized rubber in position and screw top on tightly, then loosen back one-half turn. Put on rack in oven having jars about $1\frac{1}{2}$ in. apart. Process at 275° F for 35 minutes for pint jars and 45 minutes for quart jars. When cool enough to handle remove from oven and complete seal. Invert jars.

Tomato Cocktail

18 ripe tomatoes
1 cup chopped celery
$\frac{1}{2}$ cup chopped onions
3 sweet green peppers
1 sweet red pepper
2 tablespoons salt
2 tablespoons vinegar
$\frac{1}{4}$ cup sugar

Wash and cut tomatoes, but do not peel. Chop the peppers finely. Mix tomatoes, celery, onions, peppers and salt together. Boil for one-half hour. Strain through a coarse sieve. Add the vinegar and sugar. Boil 3 minutes. Seal in sterilized jars.

Stuffed Tomato Salad

4 medium-sized tomatoes
4 hard cooked eggs, chopped
$\frac{1}{2}$ cup chopped celery
2 tablespoons chopped green pepper
$\frac{1}{2}$ cup salad dressing
Salt and pepper to taste

Cut tomatoes almost through twice, to form petals, and place in lettuce cups. Combine remaining ingredients, season to taste, and pile on tomatoes.

Variations

Potato salad mixture
Vegetable salad mixture
Any left-over cold meat, diced
Cottage cheese

Broiled Tomatoes with French Dressing

6 firm medium-sized ripe tomatoes
$\frac{1}{2}$ cup French dressing
2 tablespoons cracker crumbs
2 tablespoons melted butter

Cut a thin slice from the top of each tomato. Then hollow them out slightly. Place one teaspoonful French dressing in the hollow of each tomato. Combine cracker crumbs and melted butter and sprinkle a little on each tomato. Arrange on a baking pan and broil about 10 minutes, or until the tomatoes are tender. They may be baked at 375° F for 20 minutes if desired.

Chutney

$1\frac{1}{2}$ dozen tomatoes
$1\frac{1}{2}$ dozen apples
2 red peppers
9 onions
$1\frac{1}{2}$ pints cider vinegar
3 pounds brown sugar
$\frac{3}{4}$ pound seeded raisins
1 ounce ginger
2 tablespoons salt
1 teaspoon cloves
1 teaspoon cinnamon

Chop the vegetables and fruits, add spices, sugar and vinegar, and boil for one hour. Yield 10 pints.

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GRASS PASTURES

IT is a commonly known fact that as a result of constant cultivation of the same kind of crop much of the soil of this country has become so exhausted and deprived of humus to such an extent that it has become practically worthless for the production of crops. On such soils, no satisfactory results can be obtained even when fair quantities of fertilizer are applied.

Judicious application of a system of crop rotation is essential, if this disastrous condition is to be improved or prevented. When the texture of the soil has deteriorated to such an extent that even weeds no longer flourish in it, the fertility of the soil can be regained only after a long period of time and at great cost and even then only partially. It goes without saying that any soil which is washed away remains a permanent loss.

Importance of fallowing

Many farmers have come to realize the importance of allowing their lands to rest from time to time, or as it is sometimes called, to lie fallow. Some try to maintain the humus content of their lands by ploughing stubble or green-manuring crops into the soil. Sometimes kraal-manure and compost are strewn over the ground in order to prevent deterioration of the fertility and texture of the soil. Although the value of these attempts is fully realized, it is felt that the inclusion, wherever possible, of grass pastures in the system of crop rotation should play a very important part in our mixed-farming systems. From the point of view of cattle farming also, it is of the greatest importance for the development of a sound and improved system of farming.

When grass pastures form a part of the rotational cropping system, the soil remains in production even during the period of rest, and if the necessary fertilizer is applied to the pastures, the fertility of the soil will be maintained. Attention has often been drawn to the high production capacity of such pastures.

When mention is made of grass pastures, the impression is often gained that they are intended to be of a 'permanent' nature. This idea is partly erroneous, and it would be better to think of it as a pasture which will yield profitable results for a limited number of years. Pastures such as Rhodes grass, *Paspalum dilatatum*, Italian rye-grass, etc. deserve chief consideration in this connection. The inclusion of these grasses in the rotational cropping system will do much to improve and build up the texture of the soil.

Rotational cropping

The life of these grass pastures in the rotational cropping system will vary from two to three years, depending on the climate and the soil. It will be necessary for the farmer to make a careful study of his soil and pasture. As soon as he finds that the vitality of the pasture is declining and that economical production can no longer be effected by the application of fertilizer, the time has come for the pasture to be ploughed under; for the next few years the ground may be planted to such crops as mealies, potatoes and legumes.

The system of alternating pastures with annual crops has for many years been practised very successfully in various parts of Europe in areas where intensive cultivation takes place. Where this system is practised in South Africa on a smaller scale, a remarkable difference was apparent between the growth of the subsequent crop and that of crops on adjacent lands where the same crops are cultivated year after year. The crops following on the pasture showed much better growth, and the texture of the soil which had been under pasture for some years was much better, finer and more crumbly. Where continuous cultivation of the same kind of crop, e.g. mealies, had taken place, the texture of the soil was poor and inclined to break into clods, which made cultivation very difficult.

This notable improvement of the texture increases the water absorption and retention capacity of the soil with the result that

run-off is diminished. This is of importance in soil erosion control.

The adoption of a sensible system of rotational cropping and the application of fertilizer will help the farmer to reverse the process of deterioration of soil fertility. The fertility of our soil can be preserved and increased. If these fundamental ideas are not only borne in mind, but also regularly and actively put into practice, the fertility of our soil can be retained and increased. Only by following such a course shall we be in a position to entertain any hope of developing in South Africa a permanent and profitable farming system which will ensure the future of the farmer.—A. J. Van den Berg, Extension Officer, Greytown, in *Farming in South Africa*, May 1941.

New Books and Reviews

Soil and Sense

By MICHAEL GRAHAM with a preface by Sir E. JOHN RUSSELL. (Faber and Faber Ltd., London, 1940, pp. 244, 7s. 6d.)

IN more than one of his books H. G. Wells has insisted on the need for interpreters of science, i.e. those who can tell the ordinary man something of the results of scientific research. Here is a case where such interpretation has been admirably done.

Like so many books published at present, this one deals with the value of humus in the soil and deals particularly with the manurial value of turf.

In these days, when so much has to be produced so quickly from the land, it is worth while keeping in mind the need to leave the fertility of the land unimpaired. The author lays great stress on R. H. Elliot's system published as *The Clifton Park System of Farming* in 1908, of which the four main points are as follows:

'1. The success of our (i.e. British) agriculture depends on the cheapening of production.

'2. The cheapest food for stock is grass.

'3. The cheapest manure for soil is a turf composed largely of deep-rooting plants.

'4. The cheapest, deepest and best tillers, drainers, and warmers of soil are roots.'

The author is somewhat afraid of the British campaign for the wholesale ploughing up of grass and apparently has before him the necessity of utilizing grass as part of any rotation in order to replace the lost humus in the soil, particularly in an age when mechanical power has so largely replaced animal power with the resulting decrease in dung for manure.

The writer has the gift of tongues and many of his remarks are eminently quotable. The following are a few:

'Nitrogen as a gas is the main constituent of air. In our breathing it is merely a diluent; it is the water that we drink with the whisky. In the nourishment of the world, however, it plays a tremendous part. If we can sell nitrogen off the farm without impoverishment of the land, it must come from somewhere. The solution of the mystery is that this also comes originally from the air, as the constituents of starch do. Nitrogen reaches us eventually because some of the soil bacteria can eat it out of the air.' (p. 62)

'Sooner or later, we must put back the minerals that give life to the hill pastures. Slagging and liming and sowing wild white clover cost money, but Stapledon has shown that the work can earn a profit. Even if no profit could be shown by book-keeping, the restoration will have to be made. Neither health services nor battleships show a book-keeping profit. The hills are part of our health and their grazings form part of our fighting strength.' (p. 71)

'The certainty of the results really depends on three faculties in the experimenter. Firstly, there is common sense, which counts for a lot. Secondly, a critical or fault-finding nature is invaluable. Thirdly, the experimenter needs knowledge of all the other things that may make plants grow better or worse. Farmers are just as likely to have the gifts of common sense and criticism as scientists, and although they may not be so well versed on the chemical side of the experiments, they are likely on the average to know better what nasty little things might be interfering.' (p. 81)

The book is written for a British audience and deals with British conditions, but its sane and informed outlook on life and soil fertility make it worth reading by farmers in any part of the world.—(W. B.)

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Bal-Vihar arthat Sugam Falwadi

By S. S. BHAT, M.AG. and D. A. PATEL, B.AG. (S. S. Bhat, Raopura, Baroda, 1938, pp. 80, Re. 1)

THIS book deals with horticultural development and the subject-matter is divided into 17 lessons including cultivation, manuring, irrigation and pruning of

fruit trees and harvesting, marketing and preservation of fruits.

This easy and interesting exposition is likely to be useful for school children in elementary schools. It is written in the form of dialogue between elders and children. The dialogue is written in a simple and popular form. The language is non-technical and attractive and there are excellent illustrations. The book is likely to popularize not only the growing of fruit but the cultivation of the habit of eating fruit.—(W. J. J.)

From All Quarters

YIELD OF GRAPES IN INDIA

RECENTLY a statement appeared in *The Times of India* and some other papers that the yield of grapes per acre in India exceeds that in any other grape-growing country in the world.

Grape vines are capable of bearing and yielding a certain amount of good grapes; but they can be forced to yield much more heavily than this normal amount by liberal supply of manures, heavy irrigation and clean cultivation. But when so forced to yield heavily the vines are incapable and fail to ripen their fruit properly—by ripening is meant the development of the colour, flavour, and texture characteristic of the variety.

In comparing the yield of grapes per acre in India with that in other countries, the quality of the grapes does not seem to have been taken into consideration.

In California (U. S. A.) more than half a million acres are under grape vines. They raise good grapes for the table, raisins and vintage. The average yield of good grapes per acre is 3 to 4 tons and does not exceed 5 tons to the acre.

In the Bombay Presidency less than a dozen varieties of grapes are grown. But the variety known as Bhokari is much in favour with growers and is extensively grown for the simple reason that it bears splendidly. As a table grape Bhokari will not compare favourably with other varieties which bear sparsely and hence are not much grown.

With judicious use of manure, irrigation and other cultural treatment, the Bhokari variety is capable of giving 5 tons of good grapes per acre. When the yield is 5 tons per acre, the bunches are of medium size, from 6 to 9 in.; the berries compact and well set, of medium size, pale purple in colour; skin thick and tough, flavour sweet with right proportion of acid and sugar so that the grapes are much relished in the hot season. The grapes will keep well for about a week and stand transport to distant places without spoiling. It may, however, be noted that all early grapes in January and February are sour; it is only from March that the grapes attain their rich, sweet flavour.

With a liberal supply of manure and irrigation the vines are forced to yield much more heavily, as much as 10 tons to the acre, which is twice the amount of a normal crop. But when so forced the vines fail to ripen the grapes properly. The bunches are large, from 9 to 12 in. or more; the berries are big, well set, pale-green in colour; the skin rather thin; flavour pale or insipid to the taste. The grapes also lose their keeping quality and will not keep well for more than four days; they get much damaged in transport due to handling, the berries being very watery and thin-skinned.

Thus it will be seen that though the yield of grapes per acre in India is more than in any other country, it is irrespective of the quality of the fruit produced. Normally grown grapes in India yield approximately the same quantity of fruit as found in other countries.—H. V. Gale, Nasik.

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ESSAY COMPETITION RESULTS

THE following have been awarded prizes by the judges (Rai Bahadur Man Mohan, M.A., Deputy Director of Public Instruction, Punjab, and L. Bal Kishan, P.S.C.S., Deputy Registrar, Cooperative Societies, Multan) in the essay competition held recently by the Board of Economic Inquiry, Punjab:

Part I—Personal Field Investigation

First Prize (Rs. 50). Mr Chander Bhan Valecha, Hailey College of Commerce, Lahore: 'Calico-printing at Kahror Pakka, Multan district'.

Second Prize (Rs. 20). Mirza Sultan Ahmad Beg, Misri Shah, Lahore: 'Practical Points to increase the Economic Conditions of the Punjab'.

Third prize (Rs. 15). Mr Ish Kumar, Hailey College of Commerce, Lahore: 'Twenty Years of Motor Transport in the Punjab'.

Part II—Based on Published Material

First prize (Rs. 20). Moreshwar V. Mauskar, Hailey College of Commerce, Lahore: 'Subsidiary Industries—the only Solution of the Peasants' Problems'.

Second prize (Rs. 15). Mirza Sultan Ahmad Beg, Misri Shah, Lahore: 'Improvement of Soils for Crop Production'.

Third prize (Rs. 10). M. Shamim Sahrai, Model School, Talwandi Musekhan, Gujranwala district: 'Punjab's Economic Problems and their Remedies' (In Urdu).

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CHANGES IN DESIGNATION

THE Governor, North-West Frontier Province, has been pleased to order that the designation of the undermentioned heads of departments shall in future be as follows:

Agricultural Officer, North-West Frontier Province, to be Director of Agriculture, North-West Frontier Province.

Superintendent, Civil Veterinary Department, North-West Frontier Province, to be Director of Veterinary Services, North-West Frontier Province.

***

'VEG.'—£20,000,000

BRITAIN'S amateur gardeners are responding to the 'Dig for Victory' drive by growing on their 1,600,000 garden allotments vegetables to the value of £20,000,000 a year. In addition, hundreds of tons of vegetables are being grown on railway embankments throughout the country. The Southern Railway alone have 13,000 allotments covering an area of 600 acres.

Even densely populated London has found room for over 38,000 allotments, while in the famous parks of the Metropolis an additional 350 acres are being farmed for food crops and 600 acres set aside for sheep grazing.

London's railwaymen are cultivating 2,700 of these allotments, covering 100 acres, while other workers of the London Passenger Transport Board have dug up 36 acres from which they hope to get 400 tons of potatoes. They are also working 120 acres of market garden land at London's chief bus depot.

Altogether apart from this, the London County Council is now farming 4,000 acres in the City's Green Belt and today the citizens of London own 15,000 head of pedigree cattle, 3,000 pigs, 7,000 head of poultry and 550 sheep.

Last year the City's farms had a record production of 360,000 eggs, 550,000 gallons of milk, 351 tons of meal, 1,668 tons of vegetables and 81 tons of fruit.

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BULL WITH ONE HORN

RECORDS of 25 years' standing were beaten when a bull sold at the British Friesian Cattle Society's annual show and sale made 3,100 guineas. He was Mr W. G. Player's Ednaston Zwarthak 25th., and, despite the recent loss of a horn, he won the championship and made the highest price in a sale at which the 70 animals offered realized £27,630, an average of no less than £394 per head. This compares with an average of £125 in 1940 and £60 in 1937. Two other bulls ran into four figures, the Hodge Bros., Fintloch Knight being sold at 1,350 guineas and Mr T. E. Beckett's Hales Zwart Thane at 1,000 guineas. The highest priced female was Fintloch Juliana 4th., also from the Hodge Bros.

Although breeders found these sensational prices highly gratifying, they believe that the real success of this British Friesian festival was the combination of great individual merit with exceptional milk and butterfat production. It is noteworthy that the qualified females averaged exactly twice the price of those which did not qualify by the milk and butterfat of their two nearest dams.

MGIPC—M—III-1-9—14-7-42—2,000.

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INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. III AUGUST 1942 No. 8

FOOD PRODUCTION FRONT

It's all one front : you've got your bit of line
To guard with your lifeblood, and I've got mine,
We can't change places, I've my job to do,
Until I drop, and it's the same with you,
But we will stand together when the brunt
Of Evil's onslaught falls : it's all one front.

—Jan Dys

THE food production drive is well under way. Paragraphs in the daily press in the last three months dealing with action taken by various provinces and states and the excellent reports, published in our recent issues, of food production work in the provinces and states are proofs. All this is a direct contribution to the winning of the war.

The Winning of the War—that must be our overriding ideal.

Landowners, farmers and agricultural scientists share this united effort. In the 1914-18 war, throughout Great Britain there was a great development of 'allotments'. These were small patches of soil, worked by individuals in their spare time and generally employed for the growing of vegetables for family use. These allotments were not necessarily in the gardens of the individuals who worked the allotments (many of these people had no gardens at all), but in the neighbourhood of every town or city there are waste spaces and sometimes parks and playing fields which were parcelled out to individuals who were prepared to work them.

In the present war allotments have again produced a great deal of vegetables in Great Britain. An article by Sir John Russell, describing the work of home prodecers of food and other aspects of the food production drive in Britain, appears in this issue of INDIAN FARMING. In 1939 the Ministry of Agriculture in Great Britain (in Bulletin No. 1, *Food from the Garden*) gave a cropping plan for such an allotment, indicating the area to be devoted to each crop, the time of sowing and the period of use for each crop. Out of the many such gardens and allotments planted in this way during 1940 in most towns in England and Wales, 98 allotments each of 300 sq. yards were selected and records made daily of the weight of the crops from the time of gathering. The yield for one year from such a 300 sq. yard allotment reached the figure of 411 lb. of potatoes and 1,085 lb. of other vegetables, and this was spaced fairly evenly throughout the year due to the way in which the sowing had been done. Similar advice has been given in America and a very good table of planting dates and the amount of seed required for a long list of vegetables to be planted in Southern California has been given in the *California Citrograph* for February 1942.

India is so huge and conditions vary so much throughout its length and breadth that no simple table of this kind can be drawn up for India as a whole for the benefit of those who desire to cultivate areas of the allotment type, but the information exists for smaller areas for

provinces or states and even for divisions or districts.

Where general guidance is required and no expert is at hand, one cannot do better than consult Firminger's *Gardening in India* in the section headed 'Vegetable Garden'. Though written many years ago, the advice is that of a practical gardener and most of it holds good today. Firminger prescribes generally for only two parts of India, i.e. the so-called hills and the so-called plains—a definition carrying a good deal of meaning to those who live in northern India but of little significance to those in the west and south. For dwellers in the Punjab we recommend *A Handbook on Field and Garden Crops in the Punjab* (with an agricultural calendar) by Milne and Ali Mohammad, price Rs. 3. The Agri-Horticultural Society of Calcutta and many Government gardens are sources of information and advice. The Agricultural Departments are always willing to help and have useful leaflets on the growing of many crops.

It is worth while making some calculation not only as to when one is going to get the vegetables but in what quantities, and one should plan whether the allotment is intended to feed the family or whether it is intended to have a surplus for disposal otherwise. There are many ways of disposing of such a surplus. Many of the 'thrift shops' opened to sell odds and ends and make money for war purposes deal in vegetables. Many hospitals are glad to have additional vegetables for the use of their patients. Where there are large camps of any sort, there is generally no difficulty in selling off a surplus provided the necessary contacts are made.

One difficulty likely to arise is the securing of vegetable seed at the present time. Of certain seeds such as onion and (in parts of India) cauliflower there is seldom any difficulty of supply. Tomato seed of a sort can generally be had but it is not always possible to guarantee the kind of tomato that is going to result. Where possible, arrangements should be made in the forthcoming year to save seed of good types of vegetables and it is proposed in a later issue of this magazine to put together what knowledge we have on this subject.

In the next issue of INDIAN FARMING we hope to devote some space to vegetable growing in northern India.

If any one has ideas, hints or tips that they wish to share, the Editor will be glad to consider them for publication.

N. V. KANITKAR

M.Ag., B.Sc.

An Appreciation

MR N. V. KANITKAR, who has for the last nine years been Chief Investigator in charge of the Bombay Dry Farming Research scheme, retired on 27 June 1942. Mr Kanitkar was born in 1887 and in 1909 obtained the Degree of Bachelor of Agriculture of the Bombay University in the first group of students from the Poona College of Agriculture to obtain that newly created degree. In 1914 he obtained the Degree of B.Sc. of the Bombay University in chemistry and biology and in 1921 was awarded the Degree of M.Ag. by the University for a thesis on rural economics entitled *Land and Labour in a Deccan Village, No. 2.* The village was Jategaon Budruk in the Poona district.

Immediately after graduating B.Ag. in 1909, he joined the Bombay Agricultural Department in the Chemistry Section as a Junior Laboratory Assistant to Dr H. H. Mann, who was then the Agricultural Chemist to the Government of Bombay and Principal of the Poona College of Agriculture. In 1910, he was appointed Demonstrator in Chemistry,

N. V. Kanitkar, M.Ag., B.Sc.
Chief Investigator, Dry Farming Research Scheme, Sholapur

and Senior Laboratory Assistant; in 1913, Lecturer in Chemistry, a post which he held for five years. He then held the post of Assistant Professor of Physics, Mathematics and Engineering for a year and later was appointed Assistant Professor of Chemistry, a post which he held for seven years. He acted as Agricultural Chemist for short periods and from 1926 to 1933 as Soil Physicist to the Government of Bombay. In 1923 he was appointed Chief Investigator in charge of the Bombay Dry Farming Research scheme, a post that he held up till his retirement.

From an early stage in his career, Mr Kanitkar was interested in dry farming and associated with the research on that subject carried out by the Agricultural Chemistry Section and located first of all in a small station at Manjri not far from Poona. In 1930-31, he went on a tour to the U. S. A. in order to study dry farming both as regards research and practice in that country. He obtained valuable information and made useful contacts during this tour.

The subsidizing of dry farming research by the Imperial Council of Agricultural Research permitted of the opening of dry farming research stations at Sholapur and Bijapur in the Bombay Presidency—the first in an area of comparatively shallow soil and the second in an area of deep black cotton soil—in both of which valuable and interesting work has been carried out under Mr Kanitkar's direct guidance. He has also been a permanent member of the sub-committees of the Imperial Council of Agricultural Research dealing with dry farming and has put his own experience freely at the disposal of other workers. He has been able to crown his work by the completion, just before retirement, of a monograph on dry farming in India which puts together in one volume the whole of the work done up to date.

Although dry farming was his main interest, particularly in the later part of his career, he has done a good deal of work in other lines of agricultural chemistry and agronomy and was associated with Dr Mann in sociological studies of Deccan villages.

He is an extraordinarily good teacher and his lectures were models of clearness and precision. He was equally good in the organization of laboratory teaching. The students of the Poona College of Agriculture remember him with gratitude and affection. A well-read man, of cheerful and companionable disposition (he is one of the original members of the Sholapur Rotary Club), we are sure that in his retirement he will find time to cultivate still more his many friends and his many intellectual interests.—(W.B.)

SID WARD, FIGHTER

UNTIL 8 December 1941, Sid Ward was a farmer. His farm was a business enterprise. He worked hard, and the land gave back to him....good things to eat, clothes, a car, a decent education for the kids. Some years, there was even a little left over.

Today, with the nation at war, Sid Ward has stopped being just a farmer. He's a *fighter*....and his peaceful, rolling acres have turned into a victory weapon just as powerful as planes and tanks and guns.

While the war goes on, Sid Ward is in the front line of a tremendous battle —the battle of *food*.—Advertisement by Westinghouse, *Agricultural Engineering*, February 1942.

Original Articles

BRITAIN'S WARTIME FOOD PRODUCTION DRIVE

By Sir John Russell, D.Sc., F.R.S.

Director, Rothamsted Experimental Station, Harpenden, Herts (England)

TO understand properly Great Britain's wartime drive for food production it is necessary to know something about the peacetime situation. Great Britain had a population of some 46 million people in 1937 of which 335,000 were actual farmers, and with their workers made up a total of 1,030,000 occupied in agriculture. If the families were added in, less than 10 per cent of the population were directly dependent on agriculture. Yet this small number of people produced some 40 per cent of the food of 46 million people. It was a great performance, better than in any other country in Europe: one worker fed on the average no fewer than 17 people. But the 40 per cent home production was not evenly distributed over all foods; we produced the whole of our liquid milk and potatoes, and half of our meat, but only about 25 per cent of our wheat and 10 per cent of our butter. British farms are in the main small: more than 80 per cent of them are 150 acres or less in area; but the farming units are remarkably stable, being mainly the area of land that one man can adequately supervise. In peacetime the main output of British farms is livestock products, the value of which in recent years was £150 million out of a total value of £220 million for all farm and market garden produce for England and Wales; livestock thus represented 70 per cent of the total value, farm crops about 15 per cent, and fruit, vegetables and glasshouse produce also 15 per cent. Our cold, wet climate imposes a high standard of nutrition, and the quantities of meat eaten were higher than anywhere in Europe.

Wartime changes: a new dietary

When war broke out it was clear that we could not indefinitely continue to import 60 per cent of our food, but it was also clear that we could not produce it all ourselves. Our peacetime dietary required about 1·6 acres of cultivated land per head of population, and we had not got more than about 0·6 or 0·7 acre per head. Something could be added by reclaiming land at present waste or at least non-agricultural, but the possible increase was not great and was more or less offset by loss of agricultural land for aerodromes, camps, etc. Two courses of action were adopted. Our national dietary was changed so as to reduce the consumption of meat, butter, and imported fruit, all of which take up considerable shipping space: correspondingly there had to be an increased consumption of vegetables and potatoes. At the same time the most intensive production of grain, potatoes and vegetables was organized. Of all things national dietaries are the hardest to alter: people are extremely conservative in matters of food, so the change had to come slowly. First of all the dieticians were set to extol the merits of potatoes and vegetables: the nation had to be made 'vitamin conscious'. Here the B B C with its so-called 'Kitchen Front' played a great part. War broke out for us on Sunday, 3 September 1939: 18 weeks afterwards on 8 January 1940, rationing of food began, but at first it was very mild, affecting only bacon, butter and sugar; the cuts were not severe and were hardly felt. Then on 11 March 1940, meat was rationed but not poultry, rabbits, game, fish or meat 'offals', and in any case the allowance was ample; there were always supplies of the unrationed foods. Not till the end of 1940 did rationing much restrict our old food habits: even now (April 1942) we really have

nothing to complain about: the weekly ration for an adult includes about $1\frac{1}{2}$ to $1\frac{3}{4}$ lb. (according to price) of meat of various kinds, including bacon; 8 oz. of fat (i.e. 2 oz. butter, 6 oz. margarine, 2 oz. cooking fat); 3 oz. cheese (but agricultural and certain other workers and vegetarians have 12 oz.); 8 oz. sugar, 2 oz. tea, 4 oz. preserves (jam, marmalade, syrup, treacle or mincemeat, but not counting honey); milk 3 pints weekly (but extra for children, expectant mothers, invalids, etc.). Tinned and dried foods are rationed on a point system—24 points are allowed per month and these can be expended in a great variety of ways—a tin being priced at from 1 to 16 points according to its contents. Eggs are not rationed but allocated: the difference is shadowy—there were 3 per head during March. Fish, however, is not rationed, and is available in moderate quantity; so also are various so-called meat offals, liver, sweetbreads, hearts and game. Moreover, meals in canteens and restaurants do not count and many of the men have at least one meat meal a day out, as do the children at school. Further, home-produced food does not count.

New home producers

Many people are now growing potatoes, vegetables, and fruit; they keep poultry to give eggs, bees to produce honey, and rabbits to increase the meat supply: some also keep goats to furnish more milk. All this is a complete addition to our old supplies. This additional home production of potatoes and vegetables has been a very great advantage. It has saved a great deal of transport, which, under present conditions, is extremely important, and it has ensured that a large number of households have some at least of their food always on the spot and always in good fresh condition.

From the outset the new food producers were encouraged to grow a variety of vegetables and especially to include any that particularly appealed to them. The B B C arranges weekly talks on the management of the garden, while, in the daily 'Kitchen Front', recipes are given for serving up the vegetables in newer and more attractive forms. So enthusiastically has the call 'Dig for Victory' been accepted that much open unused ground in towns and villages, derelict or half-used fields, parks, forecourts and other patches of land have been dug up and made to grow vegetables and potatoes. Demonstration allotments have been set up and assistance is given in a variety of ways to the newcomer. At mid-March 1942 Mr Hudson stated in the House of Commons that we now had nearly 1,750,000 allotments, practically double the prewar figure, in addition to 2 million to 3 million private gardens, and the allotment holders and private gardeners between them are producing some £10 million to £15 million worth of vegetables. The movement is still spreading, for we have been warned that next winter will be a trying time, and each man must do what he can to grow a reserve of food for himself.

New farm production

Life is so strenuous, however, and wartime duties such as Home Guard, Civil Defence, Air Raid Protection and Fire Watching are becoming steadily more insistent, that the allotment and garden effort is not likely to expand greatly. For the bulk of our home-produced food we must look to our farms. Our new dietary, allowing for the supplements due to the home garden and allotments, requires less than the 1·6 acres needed by the old one, and in consequence we have automatically been able to increase the proportion of home-grown foodstuffs and to supply considerably more than the 40 per cent fed in peacetime; this would have been the result even had no increase in food production occurred.

But alongside of this changed dietary there has been an intensification of food production. Grassland is less productive of human food than arable land and a considerable area has therefore been ploughed up. In peacetime the United Kingdom had 13 million acres of arable land and 19 million acres of permanent grass: at mid-March 1942 Mr Hudson informed us the figures were reversed and there soon would be 19 million acres of arable land. The additional 6 million acres had gone into a variety of crops: oats had taken about $1\frac{1}{2}$ million, the wheat acreage had been increased by more than 550,000

acres and the potato crop by more than 300,000 acres over the peacetime acreage of 1·6 million of wheat and 700,000 of potatoes. Vegetables also increased from 2·5 million tons in 1938 to 4 million tons; sugar beet, it was hoped, would be raised by 60,000 acres to the 405,000 which was all the existing factories could cope with.

These great increases in the areas of arable crops would have been impossible but for a large increase in the number of tractors. Here the young countryman's machine-mindedness has been a great advantage. The present generation of young people has been brought up alongside of mechanical devices and thereby gained a high degree of familiarity with them; as children they had mechanical toys; as boys and girls they had bicycles, later on motorcycles and wireless sets and the chance of watching motor cars and tractors dismantled and reassembled at the local garage. So the introduction of the tractor and electric motor on the farm came as a perfectly natural development, and there is little of the wastage due to inattention or wrong use that one sometimes sees in other countries. There are now said to be 100,000 tractors in use in Great Britain and it is further stated that our farms are the most heavily mechanized in Europe. Young women have taken remarkably well to tractor driving and the reserves of woman power in the country are still considerable.

Milk and meat output

In the last war (1914-18) we also increased greatly our area of arable land and our output of wheat and potatoes but this was done at the expense of meat and milk production, both of which fell off considerably. In this war the situation has been very different. Official figures are not available, but it seems clear that there has been practically no reduction in milk output; indeed last December the official estimate was a reduction of about 3 per cent only. Milk has been rationed because consumption rose: according to the Duke of Norfolk it is 25 per cent up; more than ever before is earmarked for children and as far as possible steps are taken to see that they get it. The result is that our children will come well out of the war with health unimpaired and not suffering from the malnutrition and deficiency diseases that the Germans are inflicting on so many of their child victims in Europe. The numbers of cattle remain high: there has been some fall in the number of sheep, pigs and poultry, though it will not be difficult to restore these after the war; pigs and poultry in particular multiply very rapidly, and the popular sheep of today are the prolific Border-Leicesters which are usually crossed with a Southdown ram or an Oxford or Hampshiredown to give the type of lamb wanted for the local market. This season, 1942, promises to be one of the most prolific on record; in our flock of 200 breeding ewes at Rothamsted we have already had 2 sets of quadruplets, 18 sets of triplets and many sets of twins. It would be interesting to speculate on the reasons for this: the shepherd associates it with the abundant growth of good grass last autumn when the rams were running with the ewes; on the other hand some of the physiologists do not accept this view. The output of meat has suffered, but there are no official figures to show by how much: probably, however, less than in the last war.

The reduction of imports has greatly affected animal nutrition also: prior to the war we imported about 25 per cent of the starch and protein equivalent required by our livestock. Much of this is now unavailable. Moreover, the closer milling of the wheat has reduced the supply of wheat offals to the animals. The ploughing up of the grassland deprives them of much of their protein equivalent and the arable crops grown instead do not fully supply the deficiency, although they go a long way. Also the arable crops furnish food both summer and winter, while the grass provides a great flush of food in summer and much less in winter. This inconvenience is being mitigated by an extension of silage, in the making of which molasses is used with advantage. Grass drying would have been useful but it was not practicable under war conditions partly through lack of driers and other equipment, partly through shortage of oil fuel on the farm. In consequence of these various difficulties our animals have less protein and

starch equivalent than in peacetime and so give lower yields of milk and of meat, and also the meat is not so well finished : it lacks the rich juiciness of the peacetime product.

New administrative organization

When the war began in September 1939, our agricultural position was certainly in some directions worse than it had been in August 1914 when the earlier war had started. We had fewer agricultural workers and fewer acres under the plough than ever before and our farmers were disheartened and financially handicapped by a series of difficult years. But on the other hand we had developed a good service of advisory officers. County agricultural staffs were in touch also with advisory scientific staffs of chemists, entomologists, plant pathologists, economists and others, who were centred at universities or large experiment stations where adequate appliances would be made available ; and the agricultural departments and experiment stations were well staffed with scientists all anxious to do their best to help in the war effort. At the outset the Ministry of Agriculture decided to set up War Agricultural Committees in each county and to give them extensive powers of controlling the operations of the individual farmers. Each man is told how much grassland he must plough up ; if he has not got the implements the work will be done for him and charged to him. He is also told what he should grow, though considerable latitude is allowed to ensure the fullest chance of success. A survey has been made of all the farms and they have been graded as A (excellent), C (poor) and B (intermediate). Enquiry is made as to why the C farms are so poor : if it is a case of ignorance and incompetence the farmer can be dispossessed and the land taken over by the War Agricultural Committee ; if on the other hand it is due to some mechanical hindrance the Committee has power to put this right. It is gratifying to record that C farms are not numerous and that dispossession has been rare. In many instances useful help has been given and productiveness increased. The War Agricultural Committees have been able to undertake large-scale improvements, particularly drainage, which for some years past have been beyond the power of individual owners. Great Britain practically never suffers from drought (except in the Eastern Counties in spring) ; our troubles are usually from too much rain and from water seeping down from higher ground and so making the land waterlogged. Drainage schemes on a proper scale effectively raise the productiveness of the land, and a number of them have been put into operation. The Committees have also ploughed up considerable areas of land which had not been cultivated for many years ; gorse-covered commons have been converted into potato fields, the commoners' rights, which all through the ages had prevented cultivation, being waived in the interests of food production. The shortage of grass has stimulated the reclamation and improvement of the so-called 'rough grazings', land which supplies a certain amount of grazing to animals but not enough to justify the expenditure of time or money on it. Methods have been devised for improving it and converting it into useful grassland. Then too, supplies of fertilizers and of feeding stuffs are strictly controlled and allocated to the different counties. Thanks to our highly efficient chemical industry we have almost unlimited supplies of sulphate of ammonia, and to that extent we are much better off than in the last war when nitrogenous fertilizers were very scarce. But we have no such large supplies of phosphates or of potash, and so it has been necessary to ensure that these shall be used to the best advantage. The use of potash is restricted to certain crops only : potatoes have a high priority, and, among vegetables, tomatoes and brassicas. So feeding stuffs have to be allocated. Priority is given to milk production, but even so dairy farmers are expected to grow sufficient fodder crops and cereals to provide the first half-gallon of milk per day ; they can then obtain concentrated feeding stuffs to increase their output. It is announced, however, that the position will deteriorate next winter and that farmers must then provide for the first gallon of milk per day.

How it is financed

Agriculture is, however, a business and

farmers can increase their food production only if they have the necessary funds. This has been provided by fixing prices which allow a reasonable margin under average conditions of farming. Farm wages have, of course, risen, and now stand at a minimum of £3 weekly for a man, the actual payments being of course higher because of overtime or special duties. Prices of farmers' requirements have also risen but not inordinately, and they are in any case controlled. The prices paid for farm produce take account of these costs and still leave the farmer under average conditions with the possibility of coming out safely. Farmers under better conditions can, of course, make considerable profits but these are taken by the Exchequer in the form of excess profit tax and income tax. Patriotism has had to replace profit as the motive for high output and fortunately for the country both farmers and farm workers are responding well to the demands made upon them. We are warned that next winter will be the most serious of all the war winters and in particular that the food situation then will be worse than anything yet experienced. But instead of depressing our people this has only stirred them to greater zeal and activity, and everywhere one sees food production in full swing to ensure that, whatever happens, the country will always have sufficient food to be able to continue the fight till victory is attained.

GIANT STAR GRASS

By B. Sen

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GIANT Star grass, described by I. B. Pole Evans in *Nature* (1 July 1939), offers unusual possibilities for a solution of two urgent needs of rural India, erosion control and fodder supply. Star grass (*Cynodon plectostachyum*) is an African cousin of our familiar *dub*, but one has to see its performance to believe what it can achieve. This grass was first collected in 1938 by an expedition of the Government of the Union of South Africa in the great Rift Valley and around Lake Victoria in East Africa. Writing of it in *Nature*, Dr Pole Evans gave the following particulars: 'Apart from its luscious and dense stand, often 3 to 4 feet in height, the most remarkable character of the plant in the veld was its amazing network of robust runners or stolons. Individual plants (during five and a half months) have covered more than 8,000 square feet of soil, and in many instances have put out runners (with offshoots) from the parent plant, measuring in length more than 50 feet. These runners and offshoots, of course, anchor themselves down firmly at almost every node. This material offers great possibilities for erosion control in areas where this grass can be successfully established.'

Will it grow in India?

To find out whether Star grass could be established in India, I obtained in 1940 through the courtesy of Dr Pole Evans a very small quantity of Star grass seeds, less than five grams. Half the quantity was subsequently distributed to different experimental stations in India, for simultaneous trials under different climatic and cultural conditions. In my own Laboratory at Almora, Star grass seeds were sown in a box filled with sterilized soil. When the seedlings were five to six inches in height, eight plants were set out in a line at the end of my only available field plot (34 ft. by 6½ ft., approximately 1/200 of an acre). Neighbours kindly placed at my disposal two additional strips of land for Star grass trials.

Hopes justified

The unusual spread of the grass and its vigorous growth in all three plots at once seemed to justify all the hopes entertained for it. In the course of four months, the eight seedlings in my own plot had spread out and covered the entire area available, and the grass had reached an average height of four feet. The plants could have covered a much larger area if their style of growth had not been seriously cramped by the limitations of the wire fence separating the plot from other experimental beds. In Plate 89, fig. 1, will be seen a single plant of Star grass, originally planted in May 1940, harvested once in January and again in June 1941, and finally uprooted in October 1941, for photographing. The fresh weight of this single plant was nearly a maund, and the weight of the hay 25 lb. This is by no means the maximum yield obtainable from the harvest of one plant, for, given the space, each node of the grass will establish itself and eventually become a gigantic plant. In Fig. 2, will be seen the growth of a single node of Star grass planted in a small flower pot (6 inches in diameter) in August 1941, and photographed on 2 February 1942. The stem of the grass was kept suspended in the air. By February, the length of the main shoot was 16 feet and the length of the lateral branches totalled 40 feet 4 inches. It must be pointed out, however, that under the unrestricted grazing conditions prevalent in India, which entail serious damage and destruction to grass in the young stages of its growth, the expected yield of fodder would be far below the maximum obtainable under ideal experimental conditions.

As I watched the astonishing growth of

Star grass in the different plots at Almora during the summer of 1940, my enthusiasm suddenly received a sharp check. Dr W. Burns brought to my attention the findings published in a report appearing in the *Agricultural Gazette of New South Wales* to the effect that Star grass is a potential poison grass. New South Wales had also imported and successfully grown seeds of Star grass but the chemists of that country subsequently found that the grass contained the deadly poison, hydrocyanic (Prussic) acid. It is well known that many cultivated plants and grasses contain hydrocyanic acid. Such plants are designated cyanogenetic plants, and they include, among others, millet, sorghum, linseed, flax, Sudan grass, Velvet grass and Arrow grass. At the beginning of my experiments with Star grass, it had not occurred to me to test it for hydrocyanic acid, because Dr Pole Evans in his report had stated clearly that not only was this grass found to be the best and most nutritious grass in the African ranching country, but it actually appeared to possess curative properties as well. To quote his words: 'It has long been the custom of stock-owners who have grazed their animals in the country around Nakuru, where they invariably suffer from "nakuritis", to send them to the rich Star grass pasture of Lake Solai, where they immediately pick up in condition and recover.' The findings of the Australian chemists, however, necessitated both chemical analyses and actual feeding trials with the Star grass grown in Almora before this grass could be recommended for large-scale cultivation in India.

When it was found from a qualitative analysis that the samples of Star grass grown in Almora did contain hydrocyanic acid, my first task was to notify the different departments to whom I had sent seeds of the possible danger and to uproot the young plants from my neighbour's unfenced plot, for it is extremely difficult in this part of the hills to protect grass in the open from the scythes of unbidden Kumaon grass-cutters. The other two patches ultimately survived the attention of the villagers, because of rumours judiciously circulated that the grass was extremely poisonous.

Cyanide poisoning

Hydrocyanic acid, which is one of the deadliest of all poisons, acts very quickly. It has been determined that a single dose of pure hydrocyanic acid, weighing only eight grains, administered by mouth, will kill within a few minutes a cow weighing 500 lb. Some of the symptoms of cyanide poisoning are drowsiness, muscular twitching, extreme difficulty of breathing, the inability of the animal to stand. In cyanide poisoning, the processes by which blood supplies oxygen to the tissues necessary for life activity are suspended and the tissues are consequently starved of oxygen, in spite of a sufficiency of it in the blood. Characteristically, the venous blood remains bright red. If the action of the poison can be stopped before the tissues are killed, normal life can be restored. Chen, Rose and Clowes found that a combination of 22·5 milligrams of sodium nitrite and 2 grams of sodium thiosulphate per kilo (2·2 lb.) bodyweight intravenously injected was a very effective antidote for cyanide poisoning.

It has been experimentally determined by several investigators that the minimum lethal dose, administered by mouth, is in the neighbourhood of 2·315 milligrams per kilo bodyweight of the animal. According to this calculation, an animal weighing 500 lb. consuming very rapidly 5 lb. of grass containing as much as 0·02 per cent of hydrocyanic acid should die, and obviously any such grass should be considered dangerous. For a quantitative analysis of Star grass, samples were sent in August 1940 to the Imperial Agricultural Chemist, New Delhi, and to the Biochemist, Imperial Veterinary Research Institute, Mukteswar, in the following October. Their reports indicated that the samples were to be considered dangerous, for the August sample was found to contain 0·0196 per cent of hydrocyanic acid, and the October sample 0·021 per cent. Despite these discouraging reports, further explorations of the practicability of Star grass for fodder were not abandoned, since it is well known that the hydrocyanic acid content of a plant varies according to (i) the age of the plant, and (ii) the climatic and soil conditions of the region where it is grown. Moreover, though on theoretical

considerations a grass containing 0·02 per cent of hydrocyanic acid should be considered dangerous, under actual conditions it may not prove fatal to cattle. Apart from the fact that in Africa Star grass was reported to be an excellent fodder, certain experimental work with dogs by Loevenhart, Malone and Martin and with rabbits by Turner and Hulpin showed that these animals, at least, possess a natural capacity to *detoxify*, in the course of an hour, nearly half the minimum fatal dose of hydrocyanic acid. Again, a previous feed of starch concentrate or of any substance which can release sulphur into the blood acts as an antidote to cyanide poisoning. It is only when the poison enters the blood-stream at a rate faster than natural detoxification can take place that fatal poisoning occurs. Thus, for example, a cow weighing 500 lb. could automatically detoxify in the course of 24 hours the poison contained in 60 lb. of grass containing 0·02 per cent of hydrocyanic acid, and should suffer no ill effects. This assumes that the animal would consume the grass at the even rate of $2\frac{1}{2}$ lb. per hour for 24 hours which, of course, would be an impossible proposition. Therefore, in 1941, two sets of experiments were undertaken: (*a*) actual feeding trials with Star grass, and (*b*) a series of quantitative estimations of the hydrocyanic acid content of the grass at different stages of its growth.

Feeding trials

Feeding trials with Star grass were undertaken in June and July 1941. Of two pairs of rabbits, one pair was kept exclusively on a diet of Star grass for a week, and the other on *doub* grass. At the end of the week, no difference between the two pairs could be observed. The next feeding trials, with cattle and sheep, were undertaken with the cooperation of Mr J. R. Haddow, who sent the experimental animals from the Veterinary Research Institute at Mukteswar. The first animal, a vigorous bull-calf weighing 253 lb., was starved for 18 hours before the feeding experiment with Star grass began. For 48 hours thereafter the calf was given all the freshly cut grass it could eat. During this period it consumed 55 lb. of Star grass. Watch was kept at different odd hours of the day and night for any symptoms of cyanide poisoning, but none could be observed, and, with some relief, I was able to return the fatted calf to Mukteswar. Fig. 3 shows the calf enjoying a good-bye morsel of Star grass at Almora. Since the capacity of eliminating hydrocyanic acid partly depends on the vigour of the animal, and this particular bull-calf was an unusually fine specimen, a hill bull weighing 217 lb. was next borrowed for a feeding trial, and also a sheep weighing 38 lb. Both were subjected to an exclusive diet of Star grass for 24 hours, and came through without any ill effect.

The only inconclusive feeding experiment was with a locust, captured at Kathgodam railway station in December 1941, when I was on my way down to Delhi. As I happened to have a parcel of fresh Star grass with me, it seemed a golden opportunity to find out whether locusts, which are extremely rapid eaters, could be induced to consume a sufficient quantity of Star grass to suffer fatal consequences, in which case the grass might be cultivated in locust breeding areas for its lethal rather than its nutritious properties. Whether the brute had made up its mind to go on hunger-strike in protest against its captivity inside an inverted glass, or whether it was exercising instinctive discretion, it refused to offer any scientific data, for it did not touch a single blade from the abundant supply of green tops of Star grass placed within its reach inside the glass.

Chemical analyses

Quantitative estimation of the hydrocyanic acid content of Star grass was simultaneously undertaken together with feeding trials. On 30 June 1931, the samples of the grass used for feeding experiments were found to contain 0·0059 per cent of hydrocyanic acid. On 31 July, however, samples from the same patch showed a lower percentage, namely 0·0044 per cent, but the second growth (one month old) from plants previously cut for feeding trials showed a higher percentage, 0·0068. The content of hydrocyanic acid in this second growth of grass was subsequently found to decrease progressively from the end of July to January 1942, when the percentage of hydrocyanic acid observed was only 0·0024. (Incidentally, Star grass has been found to withstand the cold much better than *doub*. It was still green in early January, in Almora,

and yellowed only under a heavy snowfall towards the end of January.)

A series of separate analyses of the leaves and stalks of Star grass revealed the interesting fact that most of the poison is contained in the leaves: for instance, on 1 July 1941, the leaves contained 0·0152 per cent and the stalks 0·0016 per cent; on 29 December 1941, the leaves showed a percentage of 0·0093 and the stalks of only 0·0005, which was of the order found in *doub* grass in July 1941. Therefore, when Star grass is in the early stages of its growth it may be expected to contain the highest percentage of hydrocyanic acid, but the percentage even at this time is well under the theoretical danger limit of 0·02 per cent. With the development of the stalks, the percentage in the sample as a whole diminishes. Whole samples of fresh grass from plants grown in pots (Fig. 2) in which the development of the leaves was restricted showed in January 1942 only 0·0013 per cent of hydrocyanic acid. The concentration of poison in the leaves may very likely explain the higher percentage of hydrocyanic acid observed in the samples sent for analysis to New Delhi and Mukteswar in 1940, when only the green tops of the grass were submitted. The sun-dried hay of mature Star grass (in which the proportion of the stalk is 50 per cent or more compared to the leaves) contains an entirely negligible amount of hydrocyanic acid. This is the finding both of the Imperial Agricultural Chemist, New Delhi, in 1940, and of this Laboratory, in 1941.

Star grass is safe

From these results it can be concluded that for controlled pasture Star grass offers immense practical possibilities as a safe green fodder and hay. As yet I have received no reports of any results obtained from any of the stations in India to which I sent seeds for experiment. A circular letter from the Division of Soil and Veld Conservation of the Union of South Africa, Pretoria has supplied the interesting information that no authentic records have come to the Department's notice of any stock-poisoning as a result of hydrocyanic acid content in Star grass, either locally or in Kenya or Australia.

Though we now know that Star grass is definitely cyanogenetic, so, it may be pointed out, is our harmless cabbage. Analyses undertaken in July 1941 showed that the tender heart-leaves of a cabbage contained hydrocyanic acid of the same order as that found in Star grass, the percentage in cabbage then being 0·0054 and in Star grass, 0·0059. Nevertheless, since the average Indian cattle are far from vigorous and are often semi-starved immediately before the rains, they might be expected to consume dangerously large quantities of leafy Star grass, when the poison content is at its maximum, as soon as the rains set in, if open Star grass pastures were widely established as village grazing-grounds. Therefore, until further controlled experiments have been carried out, it is not recommended that Star grass be used as green fodder in India until the grass is at least three months old. A systematic investigation is now in progress to determine the cultural conditions likely to reduce the hydrocyanic acid content of the Star grass. The possibilities of breeding out the poison are also being explored, and four new strains of Star grass are also being investigated. Dr K. C. Sen of the Izatnagar Nutrition Laboratory is undertaking a complete analysis of the nutritional aspect of Star grass hay.

In the meantime it can be stated that mature Star grass hay holds no risk of poisoning. Even if Star grass were cultivated for hay alone, it would add vastly to the fodder wealth of India. My small field plot (1/200 of an acre) yielded in 1940 one maund of hay, and two and a half maunds from two crops in 1941, apart from a considerable quantity of grass cut for chemical analysis and distribution. On the basis of this calculation, an acre would theoretically produce 200 maunds of hay per crop, given a rainfall of 25 to 30 inches a year, and there should be at least two, and possibly three, crops a year, depending on the climatic conditions of the region. Hence Star grass, for its dual uses of erosion control and fodder, may shortly be expected to receive considerable attention throughout India, and to be cultivated on an ever-increasing scale, replacing the poorer and less prolific varieties of grazing now available for the underfed cattle population of India.

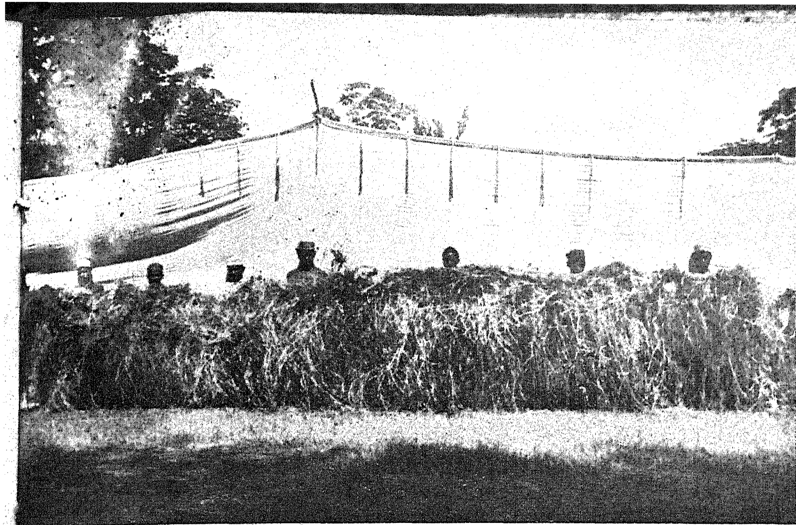

FIG. 1 (a) It took eight men to hold up a single plant of Star grass, uprooted for photographing on 15 October 1941. The original seedling was planted in May 1940 and two crops of grass were harvested in January and in June 1941.

FIG. 1 (b) This close-up clearly shows the dense matting of Star grass and its possibilities for erosion control.

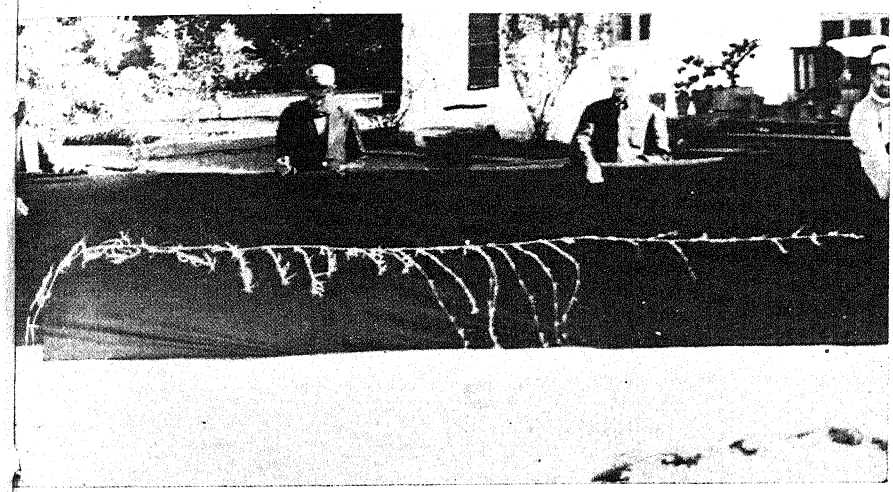

FIG. 2 Star grass is easily propagated by cuttings. One node planted in a pot in August 1941, with its shoot suspended in air, produced this main stem of 16 ft. and offshoots totalling 40 ft. 4 in. by February 1942. In the ground, a single plant has been known to cover as much as 8,000 sq. ft.

FIG. 3 A Star grass feeding experiment with this bull-calf proved highly successful, in spite of the known presence of hydrocyanic acid in the grass. After consuming 55 lb. of grass in 48 hours, the calf was still eager for more.

A nice crop of Co 419 : This cane has given a yield of 55 tons against 37 tons by J 247 in Madras and 40 tons by Co 290 in Bombay. It is replacing them.

PLATE 90

IMPROVED SUGARCANE VARIETIES IN INDIA

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AMONG the cultivated grasses (cereals) sugarcane is sown not for seeds but for the sweet juice in its stem. It requires better cultivation practices to raise a good crop of sugarcane, but only a good variety of seed will produce a healthy crop, given good climate, soil and cultivation. In the age-old practices in India less attention was paid to selection of seed. Under modern conditions improvement and selection of seed are prime factors in raising a good crop. Improvement of the varieties of cropping plants has been achieved by selection and breeding in several plants, and sugarcane is one of them.

Older varieties in India

The commonest varieties of sugarcane in cultivation, popularly divided into *Ukh* and *Ganna*, were many and the following stanza taken from the well-known work, *Susruta*, summarizes under twelve headings most of these probably in cultivation from ancient times[1]:

Iksuwargah | Bhorad shatpatra wetrakodrawakarchprabhrütayah | Techānekwidhah | Tadyathā ||Paundrakābhirukschaewa wanshakah shatporakah Kantārastāpaseksusch kāsteksuh soochipatrakah || Naipālo dierghpatrasch nielporothkoshkrüt || Ityeta jātayāh sthowlyāth ||

The thin varieties were cultivated in northern India until lately; they were poor in quality and yield. The thicker ones were grown in southern India. Some of the latter were of Indian origin; others were imported ones. In the early days, no systematic effort appears to have been made to improve sugarcane varieties, except importing a few exotic canes until the establishment of the Coimbatore Sugarcane Research Station for producing improved varieties suited to Indian conditions by plant-breeding methods. The exotic varieties were unsuited to the peculiar climatic conditions of the sugarcane belt of India. A cultivator cannot raise a good crop of sugarcane if he uses an inferior variety of seed, and poor varieties were the primary cause of poor quality and yield per acre of the sugarcane crop in the cane belt of India.

Improvement outside India

The improvement of sugarcane by breeding was not considered feasible and was not undertaken seriously until the late eighties when there was a complete failure of the cane crop in Java. Since that event and during the last 60 years, vast improvement has been wrought in the cane plant itself by modern plant-breeding. Java was the first to achieve this and its improved canes known as POJ varieties gained conspicuous success by trebling the yield per acre in Java by the wonder cane POJ 2878: these varieties were later imported into every cane-growing country. Other countries were not slow to follow the lead given by Java and today every country that grows sugarcane as a commercial crop maintains its own sugarcane research station for selection and breeding of improved canes.

Improvement in India

Coimbatore was rather late in the field, but nevertheless, during a short period of 25 years, it has achieved phenomenal success in improving the sugarcane varieties of India. Coimbatore canes are spreading to other countries where they are giving better yields than the older varieties. The fame of Coimbatore has spread far and wide as one of the leading sugarcane-breeding stations of the world.

The cane belt of India lies mainly in the Gangetic plain, i.e. in the United Provinces and Bihar. The climate here is subtropical

[1] *Susrut Sanhita, sutrasthan* 45, *slokas* 149 to 151.

and the soil is alluvial. Coimbatore was set upon producing seedling canes most suited to the climate, soil and growth conditions of this belt. The new canes were superior in both quality and yield to those already in cultivation. The crop in this area suffers from adverse conditions in its early growth period, and it is gratifying to note that the newer Co varieties have certainly overcome some of these difficulties.

In the earlier years the Java varieties, namely POJ 100, POJ 213 and J 247, were introduced and tried, along with certain others, in the Bombay Deccan and Madras and in certain parts of the latter area J 247 is a standard variety in cultivation even today, but it will soon be a back number. Other varieties were introduced later among which EK 28 and POJ 2878 are grown mostly on the estates of the Deccan sugar factories and they have given the highest yield per acre in India.

Co Varieties in northern India

The Coimbatore varieties have replaced most of the old ones in northern India but the accelerated pace was due to the Sugar Industry Protection Act of 1931. Since this event larger areas came to be cultivated with improved varieties for supplying the increasing demand for sugarcane by the factories.

The Pusa Agricultural Research Institute had to do the pioneering task of testing and introducing Co varieties in the earlier stages. Later on under the aegis of the Imperial Council of Agricultural Research, due to the phenomenal growth of the white sugar industry in a short period of five years, a chain of sugarcane research stations had to be established and today almost all the provinces of India and some of the Indian states have one or two such stations entirely devoted to testing and introducing superior Co varieties most suited to the climate and soil of the respective areas. Improvement in the methods of cultivation and other agricultural practices of cane-growing are also receiving adequate attention. Lately, many sugar factories in the United Provinces and Bihar have established miniature farms to carry out similar work.

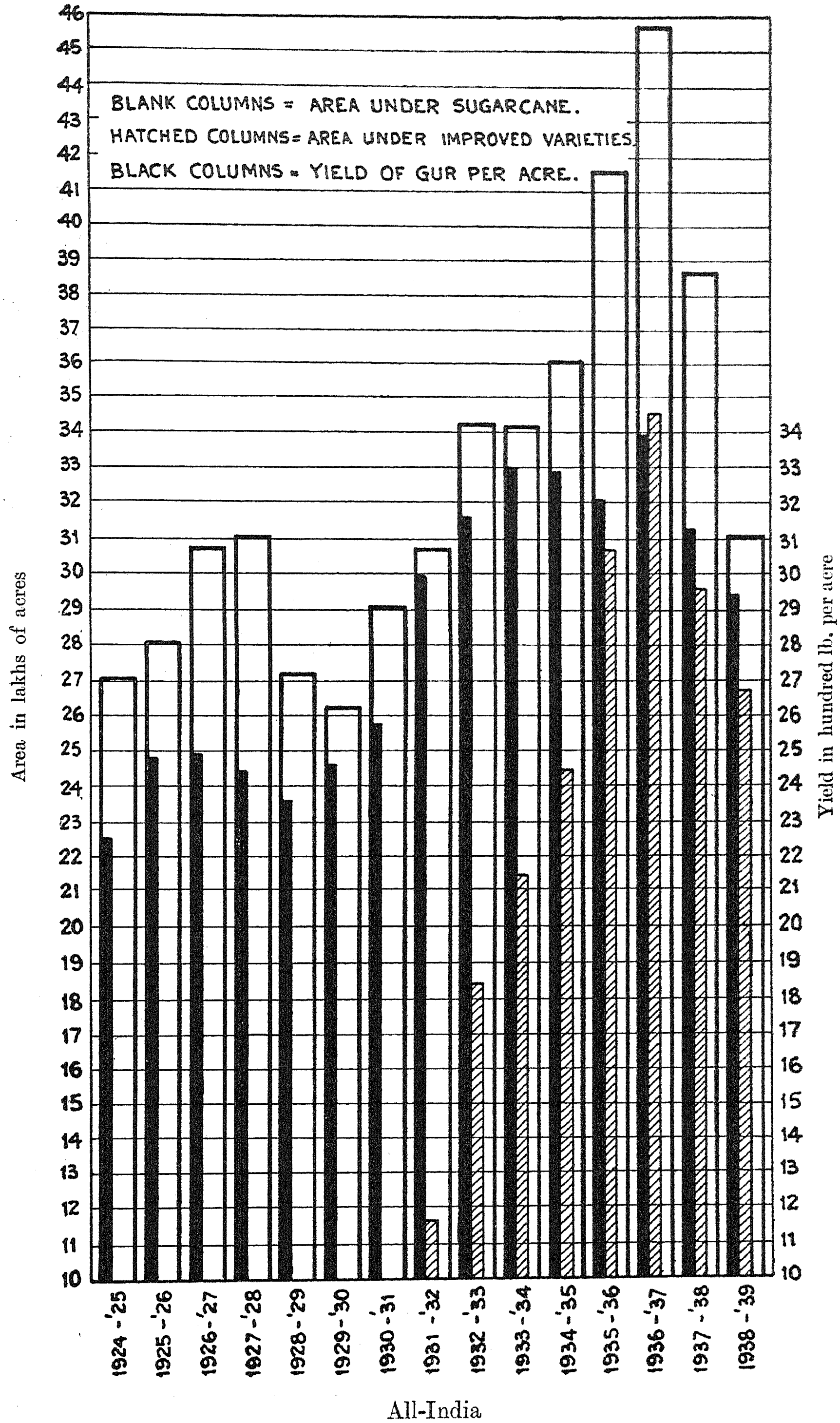
Outstanding Co varieties

In 1930-31 the new varieties Co 213, Co 210, Co 285 and Co 223 were cultivated for trial; by 1931-32, Co 213 was well established throughout India; and in North Bihar Co 214, Co 213 and Co 210 continued to replace Hemja and Bhurli. The Coimbatore canes were reported to be better in every respect than the indigenous ones. The acclimatization of the Co varieties in the United Provinces and Bihar was perhaps the greatest single achievement of the Agricultural Department during these years. By 1932-33 Co 213 was mostly grown in the United Provinces, but Co 290, Co 244, Co 300 and Co 312 were likely to replace it as the yield of the newer varieties under careful management exceeded 1,000 md. cane per acre and the average yield was about 600 md.; in Bihar about 80 per cent of the area under cane was under improved varieties. At the same time Co varieties were also under trial in other provinces, namely Co 205, Co 223 and Co 285 in the Punjab, Co 213, Co 281 and Co 313 in Bengal, Co 223, Co 243, Co 290 and POJ 2878 in Assam, Co 10, Co 219 and Co 237 in the Central Provinces and Co 213 and Co 290 in the N.-W. F. Province.

Early and late varieties

In 1926-27 for the first time work was started on breeding thicker varieties. To expand the crushing season of the factories, whose capacity was already increased, it became necessary not only to have an early maturing cane but also a late maturing one and hence testing of early, mid-season and late maturing varieties had to be introduced. Co 299 and Co 313 were early, whereas Co 331 was late. In 1934-35, Co 313 in the United Provinces and Co 331 in Bihar gave better yields; Co 300 and Co 312 were already gaining ground. In the Punjab, Co 285 became established and the Coimbatore canes were estimated to yield about 50 per cent more than the *desi* varieties, especially Katha which is late and poor in yield.

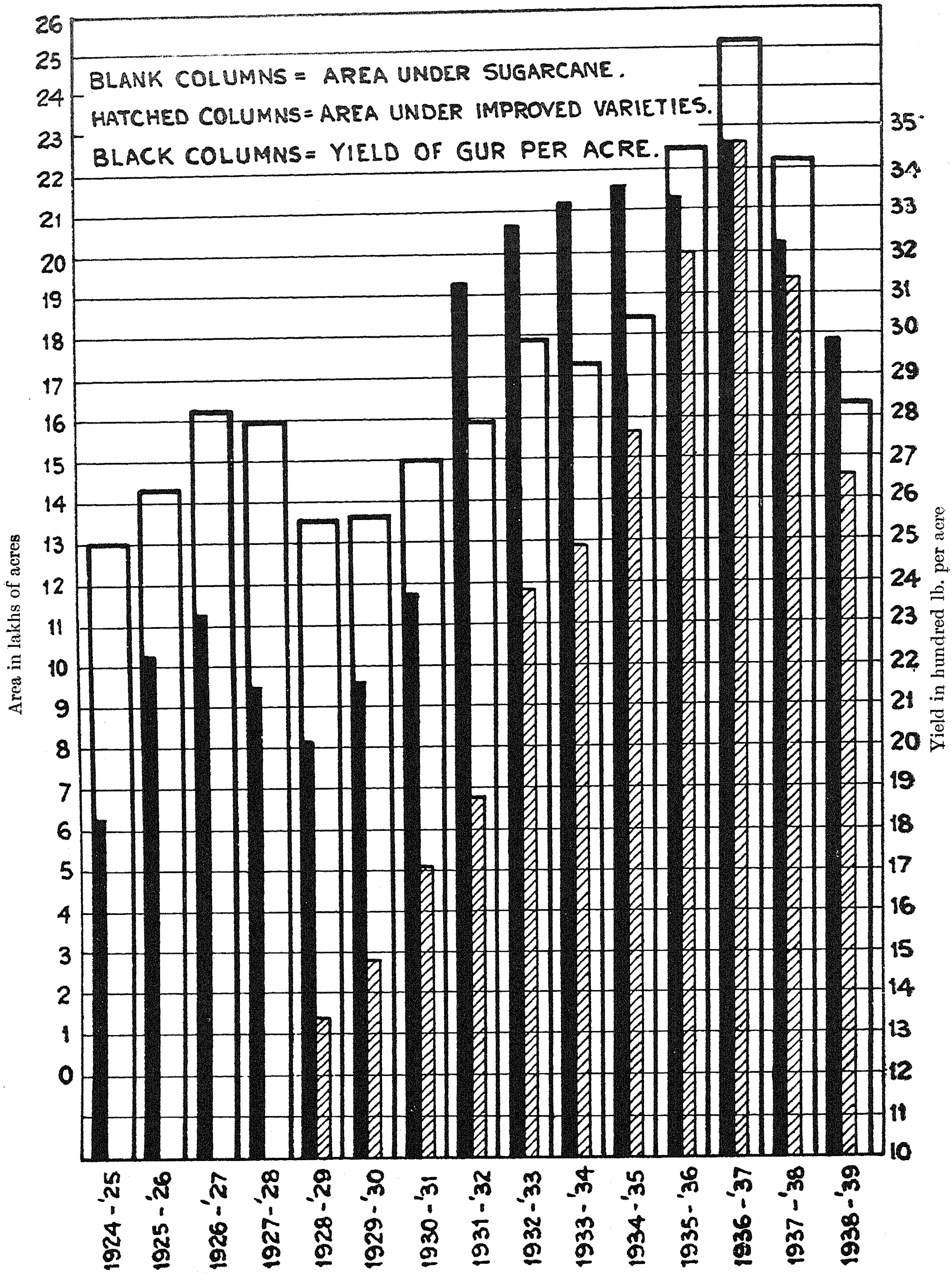
In 1935-36, Co 331 as a late cane and Co 312 as a general purpose cane were established in the United Provinces; in Bihar indigenous



All-India

Acreage under sugarcane, acreage under improved varieties and yield of *gur* per acre

PLATE 91



United Provinces

Acreage under sugarcane, acreage under improved varieties and yield of *gur* per acre

PLATE 92

canes were by this time almost replaced by improved Co varieties amongst which were Co 299, Co 313, Co 331, Co 210 and Co 213; the last one was universally grown. Of these Co 299 was early, Co 313 was medium and Co 331 was late in maturity.

In 1936-37 the area under improved varieties in the United Provinces had reached 90 per cent of the total under cane and Co 213 accounted for 60 per cent of this area; Co 290 and Co 244 were the next promising canes along with Co 312, Co 313 and Co 331. In Bengal also Co 213 became the dominant variety. In the Bombay Deccan (as already mentioned) the two Java varieties EK 28 and POJ 2878 successfully replaced Paundia on the factory estates and these were giving the highest yield per acre in India; at this time the thicker variety Co 419 was being introduced. In Mysore, HM 320 occupied 50 per cent of the total area under cane. In 1937-38 varieties Co 421 and Co 419 were found to yield respectively 44 and 53 tons cane per acre against J 247 giving only 29 tons at Anakapalle in Madras; at Gudiyattam in the same area Co 248 and Co 419 yielded 59 and 57 tons respectively against J 247 giving only 44 tons per acre. At Padegaon in the Bombay-Deccan, Co 421 and Co 419 gave better yields than POJ 2878 and Paundia. At Risalewala and Jullundur in the Punjab Co 313 and Co 385 gave higher yields and Co 396 was found to be the earliest and with yields superior to Katha. In Bihar, Co 299 and 313 occupied about 20 per cent of the area and Co 210 had declined. In Mysore, HM 661 and HM 655 gave yields of 58 and 57 tons cane per acre. At Karnal, Co 395 was found to be an early cane capable of resisting drought and possessing good habits and good juice.

Achievements of Coimbatore Station

The Coimbatore station has so far succeeded in breeding improved varieties of sugarcane for almost every part of India, largely through interspecific hybridization, employing the wild Indian species (*Saccharum spontaneum*) and noble canes. Further breeding work is designed to evolve still better varieties, as no particular variety can be a permanent one, and is bound to deteriorate sooner or later and a better one must replace it.

The economic aspects of the introduction of Coimbatore canes are clearly indicated by the two graphs depicting the average area under cane, the average area under improved varieties and the yield of *gur* per acre. Graph I is for all-India and Graph II is for the United Provinces. The period depicted is the 15 years from 1924 to 1939. Until larger areas of sugarcane were occupied by the improved Co varieties in northern India and especially in the United Provinces, the average yield of *gur* per acre for the period of seven years (1924-31) was about one ton for the whole of India and even less than a ton for the United Provinces; as the area under improved varieties increased, appreciable increase in the yield per acre became apparent. During the seven years 1931-38, the yield had increased by 50 per cent, giving an average of more than $1\frac{1}{2}$ tons *gur* per acre for all-India, whereas for the United Provinces during the same period the yield of *gur* per acre showed an increase of 60 per cent, giving an average yield of *gur* per acre always higher than the average yield for all-India. This is commendable as the United Provinces are the main factor affecting the total acreage and yield of sugarcane in India. Even during 1938-39 the average yield per acre for the United Provinces was higher than that for all-India, in spite of the very bad crop during the year.

If the area under sugarcane in the United Provinces as well as all over India is cultivated with still better varieties than those now in cultivation, the average yield is bound to increase leading to economically cheaper and better production of sugarcane. Cheaper cane of good quality will lead to low costs of sugar production which will stabilize the cane sugar industry of India.

IMPROVEMENT OF GRAZING GROUNDS IN ASSAM[1]

By R. C. Woodford
Director of Agriculture, Assam

GRAZING land is similar to all other land in that if it is desired to increase the production and improve the quality of grass, it is necessary to work on it. In Assam this work signifies clearing jungle, weeding, rough levelling, drainage of wet pockets, and finally top cultivation with top dressing or top manuring.

Deep ploughing or hoeing of grazing land is usually followed by many years of heavy weed infestation, especially the giant *Ageratum* and is definitely to be avoided.

The need for clearing the jungle and weeding is obvious. If non-edible plants are replaced by grass, the production is increased. A few trees for shade should be left. This work should be done annually preferably before the weeds form seed. Cutting is useless except for the annuals. Uprooting is necessary, and, if continued annually until the grass gets a good hold all over, there comes a time when the grass itself keeps the rest out.

Rough levelling can be done along with top cultivation of which it is a part. Hummocks and mounds are cut and used to fill small depressions.

If wet pockets exist an increase in grass production can be obtained by draining them.

Top cultivation

It is necessary to remove old roots, stubble, and mat remaining from the previous monsoon season; this is done by annual burning in the dry season. The burning is done piece by piece so as not to remove all the remaining grass at the same time. Burning is not recommended everywhere; but in the grazing grounds of Assam it is necessary. It destroys the eggs and larvæ of the internal parasites or worms which are one of the main causes of the degeneration in our cattle (nature does this in other countries by means of frosts or excessive dry heat, but not in Assam). Burning in February-March removes the coarse, inedible stubble and stimulates new growth, which also comes on earlier; it makes top cultivation easier.

The operation to follow burning is harrowing. Owing to the harder soil, the peg-tooth and chain harrows used in other countries are not enough though they do some good. The disc harrow is recommended, passing it two or three times, each time crossing the other. This is the time to do rough levelling. The harrowing also disperses and spreads dung droppings.

If the disc harrow is not available, still better results can be obtained by light sheel hoeing of grazing land. By this operation the breaking of roots, stubble and mat, aeration of the surface soil, stimulation of new growth, and the dispersion of dung droppings is very efficient. Rough levelling comes automatically at the same time. The time of year for this operation is February-March; it need not necessarily be done every year; once in two or three years would improve the grazing immensely.

Top dressing

Top dressing is best utilized if given before top cultivation which works it into the soil. Lime is good for grazing land, as it encourages leguminous plants of the clover types which have the highest food value, and makes the plant food stored in the soil available. Any quantity of lime up to 50 md. an acre will do good.

Bone-meal at 3 to 6 md. an acre is useful, lasting in effect, and cheap. But it must be sterilized. Unsterilized bone-meal is 8 as. a md. cheaper but there is danger of introducing anthrax. Basic slag at 3 to 6 md. an acre is perhaps the best manure for grass. Superphosphate is also among the best. A New Zealand grazing farmer who wants to fatten his cattle does it by feeding the land with

[1] Originally written specially for tea estates.

superphosphate. Ammonium sulphate makes grass do a quick growth but in Assam we have plenty of coarse growth; what we want is 'bottom' and sweetness which is best obtained by lime and phosphoric acid. Finely powdered oil-cake at 10 md. per acre upwards is very useful, but weeding may be necessary afterwards.

General information

We are often asked what is the correct number of cattle to be allowed per acre of grazing. It is difficult to answer because land varies so much. In one way the answer is, the fewer the better, but there is a limit to that because the coarse growth must be kept down or it soon becomes inedible under our conditions. Counting all heads except suckling calves and allowing for our small cattle, three per acre is generally the limit and two per acre is better. One buffalo is reckoned to equal three cattle.

Three months rest in the year will do grazing land a lot of good. The figure is not put higher because under our conditions more resting of the land in the monsoon would result in a coarse, inedible growth. Work on grazing land gives it a rest while the work goes on, and does it good in that way also.

If it were proposed to plough, clean, manure, and cultivate grazing land into a new seed-bed, and then re-sow it to a good grass mixture, there would be two difficulties. First a grass seed mixture suitable to the country is not obtainable as no one produces it because hitherto there has been no demand for it, and secondly it would have to be hand-weeded for some years; otherwise the new grass would be smothered, and that is expensive and troublesome.

The two most common grazing grasses in this province are known as *ulu* (*Imperata arundinacea*) and *bon-guti* (*Andropogon aciculatus*). The finer grasses, of which *dub* (*Cynodon dactylon*) is by far the best, cannot stand up against them unless the soil condition is improved and over-grazing is prevented. Under over-grazing conditions only grasses having the power to spread by an underground root can survive. But there are finer local grasses present everywhere and they will increase and spread under good management.

INDIGENOUS BREEDS OF HORSES AND DONKEYS IN INDIA

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APART from the activities of the Army Remount Department, such provinces and states as the Punjab, Sind, Baluchistan, the North-West Frontier Province, the United Provinces, Hyderabad, Mysore, Kathiawar, Rajputana, etc. have always evinced an interest in horse-breeding, and sporadic individual attempts have also been made by horse fanciers in different parts of the country. Right along the Tibetan border of British Indian territory we still find evidence of such interest and this is to some extent responsible for the existence of the Bhutia type of pony met with in the sub-Himalayan tracts from the Punjab hill states to Bengal. There is little evidence, however, of the prosecution of any settled or definite programme in regard to breeding activities and adaptation to new conditions.

Neglect of horse-breeding

The keen insight shown by breeders in other parts of the world has been sadly lacking and very little cognizance has been taken of the ever-increasing knowledge regarding genetic and breeding problems, which is mainly responsible for the present achievements of the premier livestock-producing countries. One of the main reasons, therefore, why progress in horse-breeding among the masses has not been appreciable is that the work has been in the main spasmodic and without any systematic control of breeding or education of breeders in the better care of their stock. Further, the necessary impetus this industry should have received from the landowning classes, who, in view of their status and vocation, have been mainly responsible for such improvement in other countries, has rarely been forthcoming. Along with these factors the other important contributory causes which have been responsible for the disorganized condition of the industry are the lack of properly organized and developed markets and dearth of adequate knowledge or facilities regarding nutritional and disease problems. In addition, a most important cause of the decline, as in other parts of the world, is the increasing use of machinery and mechanization of the Army. All these taken together account for the degeneration of horses and ponies in this country, and the inevitable consequence is that, with a few laudable exceptions, the horse-breeding industry is now left to the resources of the agricultural masses who, however keen they may be, can ill afford to keep it going. Moreover, the rural population in this country has always looked upon crop production as its main concern and source of income. For this reason, therefore, when a crop fails, the Indian agricultural community sinks low, and is not in a position to turn to another industry which might help it to tide over the period of scarcity.

Population and distribution

Figures published in 1936 by the International Institute of Agriculture, Rome, indicate that India ranks ninth in regard to the total population of horses in the world, while the U. S. S. R. tops the list and Great Britain and Ireland taken together range 16th in this list.

According to the livestock census, the total population of horses in British India, excluding Bengal and Bihar and Orissa, has increased from 1,393,749 in 1930 to 1,408,622 in 1935, showing an increase of 14,873 during the interval of five years. The largest number is located in the United Provinces; next comes the Punjab, then Bihar and Orissa, Bengal, the Central Provinces and Bombay.

The majority of the annual reports of the provinces and states do not contain any data in respect of horse-breeding activities, and it is presumed that wherever this information is lacking no specific action is being taken

by the provincial or state Government concerned in the matter of improvement of the local stock. The few reports which furnish some details about horse-breeding operations are those of the Punjab, the North-West Frontier Province, Sind, the United Provinces, Baluchistan and Hyderabad.

Agencies for improvement

A large proportion of the existing equine population in this country is comprised of a nondescript type. Measures for improvement which are discussed in some detail below are effected by the local Governments through district boards or other suitable agencies. The activities of the Army Remount Department were, till recently, confined mostly to small areas in the northern provinces of India, namely the Punjab and the United Provinces. The particular areas in the Punjab where the Army Remount Department concentrates its activities are Sargodha including Sargodha (Shahpur) and Montgomery districts, Lyallpur comprising the districts of Lyallpur, Jhang and Sheikhupura, and Rawalpindi comprising the districts of Rawalpindi, Jhelum, Gujarat, Attock and Hazara. Similarly, in the United Provinces, their work was confined till the beginning of 1939 to the districts of Meerut, Muzaffarnagar, Bulandshahr and Aligarh. In contradistinction to the remaining districts of the province, these districts were called 'selected districts' and the activities herein, as in other parts of the Punjab, were concerned primarily with the breeding of horses for Army purposes. These districts were selected as they had, from time immemorial, been considered districts where horse-breeding flourished naturally. In addition, horse- and mule-breeding operations were also carried on at the Government Cattle Farm, Hissar, mainly for meeting the requirements of the Army. Further, the district boards also maintain stallions at the veterinary hospitals and a few horse- and mule-breeding societies under the auspices of the Civil Veterinary Department exist for improving the local breeds of horses in their respective areas. With the mechanization of the Army, however, the Government of India decided to abandon Imperial horse-breeding operations in some of these districts with the result that the entire horse-breeding operations in the United Provinces are now controlled by the provincial Civil Veterinary Department. In addition, in the Bombay province the Army Remount Department maintained a stud farm at Ahmednagar which has also now been discontinued.

Position in Madras

Some recent information available from provinces and states shows that in Madras, Coimbatore is the only district where attempts are being made to carry out some improvement work. It is regarded as a comparatively favourable centre for the breeding of ponies and the District Board maintains a few approved stallions at stud. The annual replacements of ponies in this province are being effected by importation from Kathiawar, through the ports on the west coast and from Hyderabad, the Central and the United Provinces. The number imported each year is, however, gradually declining on account of replacement by mechanized transport and indications are that this decline will continue. In the Holkar State the Rajputs and Sondhias maintain some good mares and stallions. His Highness's Government has taken steps for locating suitable stallions of the Kathiawar breed with the object of improving the type in this area, which at one time was famous for its horses. These stallions, which are maintained by the state, are stationed at the veterinary dispensaries. A covering register is maintained and suitable rules for the use of these stallions are in existence. These measures are, however, restricted to areas where there is considerable demand for suitable stallions. In the Gwalior State, His Highness the Maharaja Scindia has made provision for the distribution of 39 suitable breeding mares. The services of thoroughbred stallions maintained in the Durbar stables are also permitted in the areas where these mares have been distributed.

Recognized breeds: Unmol

The various families of the Unmol breed are known as Harna, Morna, Hazziz and Sheehan, all of which are referred to as Unmol, meaning 'priceless'—the name being attributed to the

great value and preference put upon this breed. These animals were bred in the districts of Shahpur, Jhang, Rawalpindi, Jhelum and Pindi Gheb. The type is described as being very strong, elegant and shapely and possessing a long mane and a compact body. The popular colours are bay and grey. The height is given as 15·1 hands and the body-weight between 800 to 900 lb. The tradition is that the ancestors of this breed were brought by Alexander the Great when he invaded India. In spite of all the efforts made some years ago by the Army Remount Department to resuscitate this breed, it is now practically extinct, although various Maliks of the Punjab states maintain some Unmols. Probably none of them are pure: they contain in varying degrees the blood of imported thoroughbreds and Arabs.

Kathiawari and Marwari

The many common characteristics in the Kathiawari and Marwari breeds indicate that possibly both of them have a common ancestry, the variations noticed being due to difference in environmental and climatic conditions under which they are reared. These animals are largely bred in the Rajputana and Kathiawar states and the rulers interested in the Kathiawari breed have incurred enormous expense in establishing it. The ancestors of these breeds are said to be imported Arab stallions, a shipload of which was wrecked on the west coast of India: thus Arab horses ran wild in the jungles of Kathiawar and Bombay. That it possesses a considerable strain of the Arab is evidenced by the head of the animal, but a curious and somewhat prominent feature of the breed is the prevalence of sickle hocks. The ears which are inclined to meet at the tips are said to be characteristic. They are very hardy and enduring animals and it is possible that they could be developed in size and speed in case there were greater facilities available to the mares and young stock for liberty and grazing.

The Palitana stud, which was established in 1860, is now probably the oldest of the studs for breeding Kathiawar ponies. Ever since the time of its inauguration, the rulers of Palitana have evinced a keen interest in the improvement of this breed. The stud horses have been exhibited at the Bombay Horse Shows and other places and some of them have won laurels at the Rajkot race meetings and divisional races in Poona, Lahore and Meerut. The stud farm is situated at a village some four miles away from Palitana proper and is known by the name of 'Mokhadka Paddock'. It provides an open air system for horses from the time they are foals at foot to the time they are drafted out to be broken in for saddle or harness. It is observed that the open air method has definitely been responsible for the production of good bone and easy action which are so evident in all the horses bred in Palitana. Another good stud of Kathiawar ponies is maintained by H. H. the Nawab of Junagadh.

Exploits of Marwari horses

The bardic literature speaks in glorious terms of the heroic exploits of the Marwar studs, and the Marwari horse is closely associated with the great feats of bravery attributed to the Rathors in the annals of Rajputana. The famous charger, Chaitak, of Maharana Pratap Singh and Kaisar Kalimi of Pabuji are now as renowned as the great feats of their masters. Throughout the Middle Ages horse-breeding is stated to have been the chief occupation in Marwar. The various *thickanas* reared hundreds of horses and paid considerable attention to pedigree, discriminating breeding and proper nutrition. It is observed that during the latter period of the reign of the Moghul Emperors, the entire Rajput population of this tract formed an Imperial Service Cavalry of over 50,000 horses, which receives distinguished recognition in the *Ain-i-Akbari*. It is difficult to trace the origin of this breed with precision, but it seems probable that it has been considerably influenced by the Persian, Turkish and Arab horses, owned by wandering traders who often crossed Marwar from Kathiawar and Sind. Even at the present day, some typical animals of this breed are available and the interest that His Highness of Jodhpur has evinced in horse-breeding is now providing the much-needed impetus for the improvement of this breed in Marwar. Some of the best available stallions have

been purchased at prices ranging between Rs. 2,000 to Rs. 3,000 per animal and stationed at suitable veterinary hospitals. This animal is well known for its ease of pace, speed and hardiness. The prevailing colours are chestnut, brown, bay, grey, piebald and skewbald. Of these, the most favoured ones are chestnut and bay. About 5 per cent of the animals are cream-coloured. These animals look majestic, noble and handsome and are in great demand on ceremonial occasions.

Waziri and Baluchi

The Waziri and Baluchi breeds appear to have descended from a common stock. The former is found in Waziristan and is well known for its strength, good conformation and stamina for hard and fast work in the hills, but nowadays it is rather scarce and impure. The latter, i.e. the Baluchi, which is a larger animal, is found in Baluchistan and Derajat which consists of the districts of Dera Ghazi Khan in the Punjab and Dera Ismail Khan in the North-West Frontier Province. These animals possess a medium-sized head, well set with a medium and well-developed neck. The forehead is wide, muzzle small and fine, the shoulders well-placed, chest broad and well-developed, back fairly long, hindquarters and thighs muscular, cannons short and bone inclined to be fine. The ears are rather long, pointed, turned inwards and meet at the tips. The last feature is regarded as a typical characteristic of this breed. The height is about 14·2 hands and the body-weight approximately 830 lb. The animals are described as elegant, shapely and fast.

Hirzai

Hirzai animals are white and grey in colour and possess good, compact body with short back, well-muscled loins and level in the croup. The head is handsome, with broad forehead, and well set up on a medium-sized muscular neck. The shoulders are well-sloped and powerful, forearms strong, but the legs lack bone. In height the average animal approximates 15 hands and weight ranges between 800 to 900 lb. The original stock is stated to have been derived from a mare owned by the then Rind Chief, named Shol, by an Arab horse belonging to a European Military officer who accompanied Shah Shuja-ul-Mulk's contingent through Shoran in the first Afghan War of 1839. Representative animals are still owned by His Highness the Khan of Kalat and the Magassis' Sardars.

Spiti

The Spiti pony inhabits the Spiti tract which lies in the Kulu sub-division of the Kangra district. It is particularly hardy and sure-footed and averages about 12 hands in height. These animals possess good bone and a well-developed, compact body and are very suitable for hilly areas. Their legs are covered with coarse long hair. They are used for pack purposes or for riding. The rearing of these animals is an important source of income to the inhabitants of the Spiti tract, and there is considerable trade with Chumurti-Tibet, Rampur and Jammu states and the Kulu valley. These ponies are principally bred by farmers who keep two or three mares and seldom more than half a dozen. The Lahaul people also import these ponies and use them for pack or riding. In the Kulu sub-division, Yarkand, Lahaul, Zanskar and Ladakh these ponies are regarded as a distinct breed. The prevailing colours are dark grey, iron grey and dun but occasionally bay and black are also met with. Cream colour is, however, rare. These animals thrive in cold regions only and are capable of withstanding adverse conditions such as scarcity of food, long journeys, etc. The following account is given by the Superintendent, Civil Veterinary Department, Ferozepore, in respect of this breed:

'*Characteristics of the Spiti breed.*—Their head is intelligent-looking and fine, with remarkably sharp ears and their shoulders very good, which is a point that is very often deficient in a pony. Their backs are powerful and legs short, with good round feet. The neck is small at the setting on of the head but thickens considerably at the shoulders. The ribs are well sprung and the quarters well developed. The common colours are dark grey, iron grey and dun and occasionally bay or black.

'One of the many virtues possessed by

these ponies is their utility, secondly their ability to subsist even on a small quantity of ration, and lastly, the peculiar propensity they possess for "roughing it". Having been accustomed all their lives to rough it, the majority of ponies readily adapt themselves to circumstances which would be objectionable and prejudicial to the health of other horses.

'*Measurements.*—The average measurements are as follows :

Height	12 hands
Girth	55 inches
Shank	$6\frac{1}{2}$,,

The limits of variation are as follows :

Height	10—$13\frac{1}{2}$ hands
Girth	50 to 65 inches
Shank	6 to 8 ,,

'*The breeders.*—The real breeders belong to the tribe of Kanyats, who are high-caste Hindus. They have a perfect eye and pick out a good Spiti pony from a drove of which they know nothing.

'*Breeding operations.*—Inbreeding is practised in order to maintain the desired smallness. Speaking generally, the Kanyats think it more advisable to breed father to daughter and mother to son, than to adopt the cross of brother and sister.

'The mare comes in heat when about three years old and foals when four years of age. March and April (*Chet* and *Baisakh*) are the months of foaling. A mare usually gives 12 or 13 foals in her lifetime, but cases are known where good feeding and excellent management have brought about as many as 16 to 18 foals.

'*Management of the breed.*—From the middle of March to the beginning of October the whole drove is turned out to graze in the *jots* and pasturable areas which are claimed by the Kanyats as their *warisi* or inherited land. Generally concentrates are never given, except to those which are reared for racing or long journeys on steep mountains. In the latter case, maize (Indian corn) or barley is fed according to the requirements of the animal. The barley is parched but the Indian corn is fed as whole grain and is not ground into meal. The main ration comprises of grass or hay which varies from 5 to 15 seers according to the age or size of the animal and the nature of work.

'At the age of four years, in the month of May, the colts intended for commercial purposes are castrated. Early castration is condemned by the breeders and they firmly believe that if this operation is performed when the animal is young, it results in lean neck, weak hindquarters, pendulous abdomen and hollow back. Docking is not practised and the breeders regard it as a disadvantage.

'The yearling geldings and fillies are usually grazed together. The entire colts are kept separate. At the age of four years both fillies and geldings are bitted and broken. Grooming, though most conducive to the health of the animal, is often neglected.'

Bhutia

Bhutia animals are bred in parts of Nepal and other Himalayan regions from the Punjab to Darjeeling. The common colours are grey and iron-grey, though occasionally chestnuts and roans are also encountered. The height of a good pony averages between 13 to 13·2 hands and body-weight between 600 to 800 lb. The prominent features are : compact body, broad forehead, short thick neck, broad chest, straight shoulders, strong back, good bone, well ribbed up barrel, round muscular quarters, coarse hairy legs and long tail and mane. The feet are fairly open at the heels. This type is very popular in the hills and is used for riding as well as for pack purposes. Practically all the typical animals seen in British India are either geldings or above the breeding age.

Manipuri

The Manipuri pony is bred in the Manipur State in Assam. There has been some doubt expressed as to whether this is a distinct breed or merely a type evolved from animals in the neighbouring tracts of Burma. Reports received from Manipur and the Civil Veterinary Department, Assam, however, state categorically that this is a distinct breed and that some of the MSS which are even now available record that this breed existed in the seventh century when the then reigning king of Manipur introduced the game of polo which was played

with Manipur ponies in his state. It is pointed out that just to the west of the modern village of Khamral, there is a hill which is named after the famous Luwang clan. The slope of this hill has been, since time immemorial, utilized as the place for training horses, and even now the Manipuris break their unruly horses at the foot of this hill. In further support of the observation that the Manipuri is a distinct breed, a reference has been made to page 18 of the book entitled *My Experience in Manipur and the Naga Hills* (1896 edition) by Major General Sir James Johnstone from which the following passage is quoted :

'Manipur in olden days possessed a famous breed of ponies, larger and better bred than the so-called Burmese ponies that came from the Shan States. On these ponies were mounted the formidable cavalry that in the last century made Manipur feared throughout Upper Burma and enabled her rulers on more than one occasion to carry their victorious arms within sight of Ava, where their Raja Pamheiba erected a stone pillar to commemorate the event.'

Highly valued ponies

It thus appears that this breed, which is noted for its elegance and endurance, has been in existence in Assam for many centuries. These animals are utilized for various purposes, viz. polo, racing, and as hacks. Even at the present time, they are highly valued as military transport ponies. In point of speed, they have earned a great reputation on the turf in Assam and are now being largely used for racing in Shillong. The varied nature of the work for which these animals are utilized shows that they possess both endurance and speed. Recent reports, however, indicate that this useful breed is losing ground in respect of numbers as well as quality. Little attention is being paid to the existing stock and no attempts are being made in regard to its improvement. The owners seldom maintain an entire animal and quite frequently the males are castrated when still immature. In spite of the considerable export of these animals from Manipur, it is gathered that it is yet possible to collect some suitable stallions and mares, typical of the breed, for forming a nucleus for further development. The available description enumerates the following prominent characteristics of this breed :

Though small in size, the animal possesses a proportionate body and is sturdy and sure-footed. The head is smart and carried well-up on a clean, strong muscular neck. The face is fairly long and exhibits an alert, gentle appearance. The muzzle is fairly broad with well-dilated nostrils. The chest is broad and the ribs amply sprung. The legs are proportionate to size and of fine quality. Knees and hocks are strong, the shanks clean and straight and the pasterns possess a gradual and proportionate slope. The animal measures 11 to 13 hands in height and the body-weight is about 650 lb.

Donkeys

There are two types of donkeys common in India—the small grey and the large white. The former is dark grey in colour with zebra marking and is prevalent in most parts of India. Its average height is about 8 hands. The latter is light grey to almost white in colour and is commonly met with in the North-West Frontier Province, Baluchistan, Sind and as far down as Kathiawar. Its average height is about 11 hands.

Suggested lines of improvement

The broad outlines for a plan of improvement would be somewhat similar to those set forth by the Imperial Council of Agricultural Research in regard to the improvement of other forms of livestock, particularly cattle. The demand for high quality horses in India is limited and what little demand there is is being met to a large extent by systematic cross-breeding fostered by the Army Remount Department in a few selected districts. It is, however, felt by many interested in this subject that the pace could be accelerated and more inducement offered to breeders to produce not only a type suitable for Army purposes but also a breed of Indian thoroughbred which would suit the country's need for both racing and general purposes and be capable of competing in the world supply of high-class polo ponies.

Apart from the Army Remount Department,

the other agencies that are at present associated with the improvement of horses are the Turf Clubs and the National Horse Breeding and Show Society of India. The former, which are independent and unsubsidized organizations, have been providing about Rs. 2 lakhs annually for meetings closed to Indian-bred horses and have in addition contributed funds to the National Horse Breeding and Show Society. These funds are being utilized partly for the development of horse-breeding in selected districts and partly at the Imperial Veterinary Research Institute, Mukteswar, and the Army Veterinary Laboratory, Lahore, for research into equine diseases, which vitally affect the horse-breeding industry in this country. It is to be hoped that with increasing interest in the races for Indian-bred horses the Turf Clubs will continue their contributions to these two sides of the work. The National Horse Breeding and Show Society has, of course, since its inception, always taken a prominent lead in this matter.

Improvement of indigenous types

This, however, is just one aspect of the problem. Another, but more important one, is the question of the improvement of the indigenous types existing in the country. Nothing that has been said so far is intended to imply that in an attempt to exploit her own valuable market, India should breed nothing but racehorses. That would be an incorrect policy, for it is the indigenous animal that plays a real part in the life of the great mass of people, among whom are the agriculturists who are not interested in the bigger animals such as are used by the Army. To some extent the indigenous types still meet the demand for pack animals, saddle horses or tonga ponies and in many parts of the country, particularly in the hills and submontane tracts, they serve as the only means of transport. In such parts the villagers have to depend mainly on these animals for their daily routine and livelihood.

In taking up the question of the improvement of the indigenous breeds the point that needs particular stress is that it is not speed but endurance that is required in these animals. The test of the racecourse, therefore, which inevitably induces breeders to sacrifice everything for speed, is not only not necessary but, in fact, as we know today, may prove disastrous. An instance of this is the famous Pegu pony of Burma, which, some 30 years ago, was renowned all over the East for its powers of endurance, but is now, due to the adverse influence of racing, as difficult to find in Burma as, for example, the Unmol is in India.

The initiative in regard to any plan of improvement which it is proposed to introduce must be taken in those provinces and states that possess definite breeds of horses or ponies. For reasons already enumerated official assistance and encouragement would be necessary in the early stages of the work. Simultaneous cooperation of the breeders and the public will, however, be as necessary in this case as in cattle-breeding. The history of such development in other countries has shown that progress in such matters can be achieved and maintained only if non-official organizations take an active interest and gradually shoulder the entire responsibility. The first essential requisite for the plan would be a survey of the position all over the country and the selection of tracts where suitable breeds or types exist. Suitable stallions and mares would then be selected for the purpose of establishing the foundation stock. This would be followed by grading up of the type by a system of controlled breeding. Rules and regulations will need to be framed regarding the use of stallions and for the registration of accredited progeny. As experience with other forms of livestock has shown that the best results are invariably correlated with restricted activities, the plan of improvement should be confined primarily to small areas. Veterinary dispensaries, which are maintained all over the country, could be utilized as breeding centres and for locating the approved stallions.

Necessary steps

Along with these general observations, some of the other steps it would be necessary to take are:

(a) systematic castration to prevent promiscuous breeding,

(*b*) adequate facilities for investigation and control of diseases,

(*c*) propaganda regarding the proper nutrition and management, particularly of young stock,

(*d*) encouragement of competition by means of shows,

(*e*) provision of ready and profitable markets, and

(*f*) initiation of stud books eventually.

These are the bare outlines which might pave the way for better organization of this industry. Not only would systematic efforts on these lines lead to an improvement in the horse population of a particular province or state, but they would also provide surplus stud animals for distribution to other parts of India, where no suitable breeds exist and where there is still a demand for this class of transport animal.

In conclusion, it may be reiterated that all livestock improvement work needs patience and dogged perseverance. The departmental production of horses, as of all forms of livestock, should aim at something utilitarian—leaving it for private enterprise to develop the 'specialist' animal such as racehorses. In spite of the tremendous setback to this important livestock industry, India still possesses the remnants of some valuable stock which might form the nucleus for further development. Lest further neglect should eliminate even this amount of material, attention should be paid to the preservation of that which still remains and efforts made to build afresh.

E

WORMS AND ANIMAL DISEASES

By G. D. Bhalerao, D.Sc., Ph.D. (Lond.), F.Z.S., F.R.M.S., F.A.Sc.

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MOST of us on hearing the term 'worm' immediately picture to ourselves earthworms, silkworms, glowworms and fisherman's lugworms. It is only our second thoughts, recollecting the existence of leeches, roundworms and tapeworms, that remind us that this class of animal plays an important part in animal health. It is with these latter worms and the manner in which they affect our stock animals that we are concerned. To this list should be added the less familiar flukes and thorny-headed worms.

Nature of injury

The kind of worms dealt with in this paper are the parasitic worms which are distinct in their mode of life from the free-living worms. Knowledge of these parasitic worms dates back to very ancient times. The Babylonians, Hebrews, Greeks, Arabs, Chinese and Indians were all aware of the existence of these worms and of the harm they are capable of perpetrating upon mankind. The term 'parasite' was originally coined by the Greeks to describe those social pests who surrounded the rich men of the period; it meant 'one who dines at another's table'. The term has never lost this significance although it has been extended to include a large number of animals which live upon other animals and give nothing in return. The animals upon which parasites lay their hold are called the 'hosts'. In olden days these worms were believed to be related to snakes, and the 'fiery serpent' of Moses is one of these parasites. This old classification depended on a general resemblance in appearance and in the method of progression and has, of course, long since been abandoned. Mankind still dreads snakes, although the damage which they cause is very small in comparison with that produced by parasitic worms.

So numerous are the species of worms which affect the health of our domestic animals that the writer can by no means give even a general description of all of them but must confine his remarks to a limited number of those with which we are most vitally concerned in our country.

Parasitic worms, like all other animals, have a fully grown-up stage which is called an adult stage and younger stages known as larval stages. In their adult stage flukes are generally somewhat like leaves, tapeworms are long and broad as their name implies, roundworms are long and cylindrical, while thorny-headed worms are distinguishable from these by an armature of thorns at their head end.

Where they are found

The kind of organs of the host in which the parasites live depends on the particular kind of parasite. It may be remarked in general that no organ of the body of the host is immune from their attack. They are found superficially on the skin, inside the muscles, the body cavity, brain, eyes, ears, nose, throat, windpipes, sound organs, lungs, liver, kidneys, gullet, stomach, bowels, heart, blood vessels and even in the genital organs. Voltaire once remarked that mankind has only two fundamental emotions—love and hunger—and this, even if not strictly true for human beings, very neatly expresses the situation as regards these parasites. Each parasite is looking for a sheltered spot where it may feed and reproduce its kind in comfort and safety. Naturally, it wishes to do as little harm as possible to its host, in order not to endanger its own existence. But with the best intentions in the world, it is unable to avoid doing some damage. This may only amount to stealing some of the host's food or it may amount to actual feeding upon the tissues of the host. This undoubtedly has the most undesirable effect on the health of the host and may, in extreme cases, occasion its death.

Kinds of worms

The class of worms known as *flukes* live in the liver, lungs, bowels, blood vessels and the nose of their hosts. The liver flukes cause what is known as 'liver-rot' in sheep, goats, cattle, buffaloes and elephants. The lung flukes cause respiratory troubles. The bowel flukes produce digestive disturbances such as diarrhœa. The blood flukes themselves cause very little injury but great damage is done by the eggs they liberate. They rupture the minute blood vessels of the organs in which they accumulate and cause a disease in which the affected animals pass bloody urine or bloody stools. A diseased condition of the liver of horses is also produced by the eggs of one of these flukes. The peculiar 'snoring' disease of cattle, prevalent in many parts of India, is produced by flukes which affect the partition between the two nostrils of animals.

The *tapeworms* cause loss of appetite, digestive disturbances, colic and sometimes obstruction of the bowels of ruminants, equines, dogs, cats and domestic birds, such as fowls and ducks. The larvæ of one of the tapeworms of dogs reside in the brains of sheep and produce a disease called 'turnsickness' or 'gid'. The larvæ of the small tapeworm of dogs produce the so-called 'hydatid disease' of the liver and lungs of all domestic animals and even of man. In hydatid disease the affected organs of the body contain what appear to be watery cysts which press upon and injure the healthy tissue. Tapeworms in domestic birds cause their feathers to become dull, erect and ruffled.

There are many kinds of *roundworms*. Of these, the lung worms cause pneumonia and 'hoose' of sheep and goats. Large roundworms in calves cause digestive disturbances and obstruction of the bowels and colic in horses, calves, dogs and fowls. Hookworms residing in the bowels of animals are great blood suckers and produce a serious condition of bloodlessness (anæmia). The stomach worms of cattle and sheep also cause loss of blood, diarrhœa and colic. Eye worms in cattle, horses and dogs induce a flow of tears and a fear of light and may, in extreme cases, cause blindness. The hump sores of cattle are also caused by a kind of small roundworm. The condition known as *khoojlee* of horses is produced by the larvæ of certain roundworms. There are many kinds of bowel worms which produce digestive disturbances, colic, loss or blood and diarrhœa in domestic animals. The muscles of pigs are affected with the larvæ of a kind of roundworm. Animals infected with these larvæ become stiff as in rheumatic infection and experience difficulty in respiration and mastication and their voice becomes hoarse. Dogs harbour kidney worms and the affected animals find the passing of water painful and difficult. The urine passed may contain pus and blood. Dogs affected with gullet and stomach worms are subject to persistent vomiting which may end fatally. Some roundworms produce tumours in the stomach of horses which cause digestive disturbances. There are others that obstruct the blood vessels of horses with consequent paralysis of the organs concerned. A small variety of roundworms living in permanent copula are responsible for gapes in chickens. Certain roundworms are found in the heart of the dog and produce disease in this organ.

The 'fiery serpent' referred to previously is known as the guinea worm. It causes painful ulcers in dogs and horses and even in men.

Thorny-headed worms are found in the bowels of pigs. There they cause digestive disturbances, emaciation and restlessness.

A few domestic animals, such as cattle and horses, may become infected with *leeches* while drinking water from a pool or stream. These leeches enter the nose of the animals and cause a severe slimy discharge from the nose and may lead to the eventual suffocation of the affected animals. Occasionally they obstruct the respiratory passages and, in extreme cases, may occasion the death of their host.

There is yet another kind of damage done by some parasites while residing inside the body of their hosts. This is by the liberation of poisonous fluids (toxins) which cause a considerable disturbance in the health of the hosts. This disturbance is of the nature of epileptic convulsions, dizziness and a tendency to vomit.

Appalling damage

From this appalling list of worms and the ailments they produce it will be apparent how varied and numerous are the diseases of animals caused through the agency of parasitic worms. Although in all cases they do not immediately occasion the death of the affected animals, they prevent young animals from growing properly and cause general unthriftiness and lack of condition. The affected animals are inclined to be dull and are incapable of doing their normal share of work. Affected cows yield much less milk than those in normal condition. Dogs infected with parasites tend to groan and bite. The greatest danger, however, lies in the fact the parasites are continually at work, sapping the strength of the animal and living at its and the farmer's expense. They are like an ever open tap through which the stock-owners' profits are continually running out. Data in regard to the exact amount of the loss suffered from worm infestations in India are not available. It is undoubtedly more serious than the average individual can imagine. The writer, a few years ago, collected information regarding the loss of cattle on account of the liver-fluke disease in an area close to Almora in the Kumaon hills and it was found that in this locality alone nearly 80 per cent of the cattle die of this disease. The loss due to other worm parasites may also be appalling.

The life-histories of these parasitic worms and the manner in which they pass from one animal to the other provide some of the most amazing stories of nature. In all cases the worms lay eggs in the body of their host. These are passed from the body of the affected animal through its droppings, urine, sputum or nasal discharge. In some cases the infection of the other animals occurs by the ingestion of these eggs. In other cases, the life-history is more complicated and may take place through the intermediary of other animals, such as snails, slugs, mosquitoes, fleas, or other biting insects, lice, earthworms, water fleas, crabs, fishes, reptiles or mammals, even including man himself.

There is yet another more important aspect of the worm infestation of domestic and other lower animals and this is in the intimate relation which the parasites of these animals bear towards the worm infestation of man, in that they act either as intermediaries or reservoirs of human worms. This problem will be dealt with in a later article.

Cure for most worms

A grain of comfort, however, may be gleaned from the fact that there is a cure for most of these worm diseases, although there are some which still prove refractory to known lines of treatment. The treatment by means of drugs is, however, in many cases, a tedious and costly procedure and the best course, therefore, is to prevent the animals from acquiring worm infection. To achieve this, however, a thorough knowledge of the life-histories of parasitic worms and their mode of infecting animals is necessary.

In view of the importance of the worm diseases of the domestic animals and the enormous loss occasioned by them to stock-owners in India, it is imperative that intensive research should be undertaken on this subject in order to save our country from this huge drain on her resources. The first move undertaken in this direction was the establishment of a department for the study of worm diseases, about a decade ago, by the Government of India at the Imperial Veterinary Research Institute, and, of late, the Imperial Council of Agricultural Research has financed certain schemes for the extension of this work in the provinces.

In this short article an endeavour has been made to give in very broad outline an idea of the various types of parasitic worms found in domestic animals and the diseases they cause. In a future article it is proposed to deal with some measures that should be adopted to prevent or reduce the devastation caused by these parasites in our livestock.

What the Scientists are doing

PYRETHRUM IN MYSORE

DEMAND for insecticides is growing as a result of the wider adoption of modern methods of controlling plant pests in agriculture, and of large-scale anti-malarial measures by the Public Health Departments. Higher standards of living and hygiene also lead to the increasing use of insecticides. At present by far the greater part of our requirements are met by imports. If these insecticides could be produced in India at lower prices, a very much larger quantity would be used to the great advantage of the community as a whole. And if an efficient insecticide could be had from a plant grown locally, a useful and profitable money crop would be at the disposal of the ryot. This in brief is the reason behind the attempts to grow pyrethrum in India.

Pyrethrum is a plant of the Chrysanthemum family; it is the flower of this plant (*Chrysanthemum cinerariaefolium*) which contains the active principle pyrethrin which is a powerful contact insecticide. At the same time, pyrethrum has no corrosive or irritating properties and has no adverse effects on animals even when taken internally in small doses. This unique combination of properties has made pyrethrum the vegetable insecticide *par excellence*.

The Forest Research Laboratory, Bangalore, took up the problem in 1937. At that time, there was a widespread belief that pyrethrum could not flower at altitudes less than 5,000 ft. This was scarcely encouraging for Mysore conditions. A beginning was, however, made with a few seeds of Japanese origin, and 558 plants were raised and planted at Bangalore (3,002 ft.) in the first instance in March 1938. Rigid laboratory experiments were conducted and data collected on the soil conditions, other conditions of growth, the treatment to be accorded to the individual plants and their rate of growth. The vegetative development of the plants was quite satisfactory, but it is the flower that provides the insecticide and a flowerless pyrethrum clump is very nearly a weed. It was therefore almost with relief that the first blossoms were noticed 11 months after transplanting, that is in February 1939. About a third of the plants flowered.

This was distinctly encouraging. It did prove that pyrethrum could flower at the altitudes in the state. But what about the pyrethrin content? The insecticidal active principles of the flowers are chemically known as pyrethrin I and pyrethrin II. A number of careful analyses of representative samples showed that the total pyrethrin content of the Bangalore flowers was about 0·47 per cent compared with 0·4 per cent obtained from commercial samples purchased locally and 1·0 to 1·3 per cent from the best Japanese samples.

The next step was to find out if selection and acclimatization would improve the percentage of flowering as well as the pyrethrin content. These experiments were started in October 1939 and the first results indicate that the percentage of flowering plants has been raised in the second generation to 50 while the pyrethrin content was about 0·8 per cent. It must be remembered that the best yields of pyrethrum are in the third year and onwards. The experiments are at present still in progress but these are now enough data to warrant the conclusion that pyrethrum grows and flowers under Mysore conditions and that the pyrethrin content of the flowers, while below the best recorded values of other places, is comparable to current commercial samples in the market.

Simultaneously with the experiments at Bangalore, experimental plantations of pyrethrum were raised by the Forest Department at other places in the state, selected for their varying altitudes and climatic factors. Among these, the growth at Kemmangundi (near Bhadravati) is promising.

The experiments at the Forest Laboratory are at present continuing. These are designed to collect enough seed and planting material to improve if possible the pyrethrin content

and to record if the plant is susceptible to diseases and pests. It is also necessary to confirm the results obtained in the nursery by semi-commercial plantings on a much larger scale. The results of work so far may be summarized as demonstrating that not less than 75 lb. of dry pyrethrum flowers of between 0·5 to 0·8 per cent total pyrethrin could be produced per acre under Mysore conditions. The prospects of growing pyrethrum in Mysore would thus appear to be bright. This will shortly be put to large-scale tests.

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BREEDING WILT-RESISTANCE

AMONG the various diseases to which the cotton crop in India is subject the wilt disease is by far the most important. It occurs in all the cotton tracts of the Bombay province except North Gujerat; outside Bombay, it is found in Berar and the western parts of the Central Provinces, in the Nizam's Dominions and in the northern parts of the Mysore State and is met with also in parts of the United Provinces and the Punjab. The amount of damage to the crop varies according to locality and season. The figures collected in Bombay have indicated that the damage to the crop in the wilt-affected tracts is on an average about 5 per cent, but individual fields may show damage up to 50 per cent or more in certain years.

The Central Cotton Committee financed two schemes, one at Nagpur and the other at Dharwar, for the investigation of this disease. The scheme at Nagpur was closed down in 1928. The work carried out at Dharwar has shown that cotton wilt is primarily due to the parasitism of the soil-borne fungus, *Fusarium vasinfectum*, and that a close relationship exists between the disease and the soil temperature. The indigenous cottons are susceptible to the disease to a greater or less extent, while the exotic cottons have proved to be immune to it.

Technique of selection

The growing promise of control through the development of resistant varieties has engaged the attention of a number of workers; indigenous varieties possessing desirable agricultural characteristics and showing a high degree of wilt-resistance have been produced and given out for general cultivation in each cotton growing area where wilt is a serious problem. Some of the well-known resistant types produced by the cotton breeders of the Agricultural Departments are Jayawant grown in the Karnatak, Jarila in Khandesh, BD 8 in Broach and Verum 434 in the Central Provinces and Berar.

Experience has, however, shown that the conditioning factors of environment, viz. degree of soil infestation by the pathogen and soil temperature, which greatly modify the expression of the disease, vary from season to season and that selection in the field, therefore, does not provide a final basis for sifting plants resistant to disease from those that escape it. Selection under such conditions leads to the perpetuation of a mixture of strains varying in the degree of resistance. The field-selected strains show apparent resistance in years when conditions are unfavourable to infection by the fungus, but in a year when conditions favouring the fungus arise the field-selected strains succumb to the disease. It is obvious, therefore, that the isolation and fixation of strains resistant to the wilt disease should be done under optimum conditions of infection. A technique for the isolation of 100 per cent wilt-resistant types under optimum conditions in a glasshouse specially fitted with temperature controls has been developed at Poona. The technique provides for the testing of strains in three stages, viz. (i) the development of wilt-resistant strains of good quality and yield by the cotton breeders from wilt-sick plots, (ii) the testing of these at Poona under optimum conditions of infection and reselection of immune types from the highly resistant material furnished by the breeders, and (iii) the final testing of strains selected at Poona in the respective tracts for wilt immunity and other agronomic characters.

The selection of wilt-resistant cottons by the breeders is done by growing the varieties in a plot which has been thoroughly infected artificially with the wilt organism. The strains possessing desirable economic characters are tested for a number of years until a strain showing a high degree of resistance under field conditions is secured.

Rigorous tests

The field-selected resistant cultures are then put to a more rigorous test in a glasshouse where a uniform temperature of 25 to 27° C (the optimum range of infection) is maintained. The progeny of each resistant plant is tested separately in small tubular pots containing infected soil whose infectivity is adjusted to a uniform level. Plants showing even the slightest symptom of wilt are drastically eliminated over a period of six weeks from the time of germination, at the end of which only plants which appear perfectly normal are transplanted in a thoroughly and uniformly wilt-infected bed. The self-fertilized seed of healthy plants is again tested in the glasshouse under conditions of optimum infection and this process is repeated until a wilt-immune type is fixed.

The first stage in the breeding of wilt-resistant types is carried out under the Committee's breeding schemes sanctioned for the Surat, Broach and Jalgaon tracts where wilt is a serious menace. The second stage of the work is conducted at Poona under the cotton wilt breeding scheme financed by the Committee. Arrangements have also been made for testing, at Poona, material received from Parbhani and Raichur of Hyderabad State, where wilt is said to be spreading rapidly. It is also proposed to establish a constant-temperature house at Indore for the study of the genetics of wilt-resistance and for the isolation of resistant cotton strains for central India where the disease is slowly spreading to areas previously unaffected.

Tests over a series of seasons have shown that strains from both Broach and Jalgaon have now reached a stage when they may be said to be 100 per cent resistant to wilt. It is expected that within a short time there will be wilt-immune types available for distribution in the tracts of Bombay and the neighbouring states affected by the disease.

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Is there any centre in India where unsweetened condensed milk is manufactured ?

A. This article is now being produced at the Military Dairy Farm, Lahore Cantonment, for supply to the troops.

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Q. Does pasteurization alter or destroy the physico-chemical constituents of milk ? Does the boiling of milk as done in Indian homes differ from pasteurization ? Is the digestibility of milk a function of temperature and time of heating ? How can one measure the change in the solubility of the salts brought about by heating milk ?

A. Pasteurization does alter and destroy the physico-chemical behaviour of milk. The principal changes brought about are :

(*a*) the production of cooked flavour;

(*b*) the denaturation of the soluble proteins, globules and albumin ; and

(*c*) the alteration of ionic and colloidal form of phosphorus and calcium and hence the much delayed action of rennet coagulation.

So far as is known the destruction actually brought about by the method of commercial holder pasteurization are :

(*a*) 20 to 25 per cent of vitamin B_1 ;

(*b*) 20 to 25 per cent of vitamin C; and

(*c*) about 20 per cent of iodine by volatilization.

However, the above factors are being studied with reference to Indian milks at the Imperial Dairy Research Institute and the results may indicate some modifications. The destruction of milk enzymes like phosphatase, which acts as an indicator for testing the efficiency of pasteurization, needs to be specially mentioned. No other change of any appreciable nutritional significance appears to be caused by this process.

Both processes of heat treatment—boiling and pasteurization—amount to much the same thing, but the nutritive value is probably still further lowered by boiling.

Pasteurization and boiled milk are more readily digested by trypsin than raw milk and the increase in the digestibility of heated milk is ascribed to be a function of temperature and time of heating by Larence and Koch. Heating milk seems to facilitate its digestion as the milk then forms curd of a texture suitable for an easy attack by the various enzymes present in the human system.

One of the surest methods for the measurement of the solubility of mineral salts is to prepare milk filtrates by ultra-centrifuging and examine them for calcium and phosphorus. Another simpler method is to dialyse milk through parchment membranes and measure the amount of dialysable calcium, etc. A third method is to coagulate milk with rennin and examine the serum for minerals and note the change.

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Q. Please suggest a method for the preparation of thyroxine and encasein and water-resistant glue from milk casein.

A. The preparation of thyroxine from casein is a stepwise or two-staged iodination process. The general outline of the preparation is as follows :

Casein (2·5 per cent) is treated with one-fifth of its weight of iodine in the presence of 0·75 per cent soda bicarbonate at 37°C. This yields a product possessing 6 to 8 per cent of organic iodine and having 300 to 500 guinea

pig units thyroid activity per gram. This iodocasein after cold baryta hydrolysis gives an active preparation acquiring 10,000 to 20,000 units per gram and 40 to 50 per cent iodine. The yield of crystalline thyroxine varies from 50 to 100 mgm. per gm. of casein. Thyroxine is also obtained by the controlled hydrolysis of thyroid gland with barium hydroxide and subsequent purification. Further details about the process will be given if required.

Encasein is a commercial preparation from casein, which is sometimes used as a food for people suffering from stomach and lung troubles. It is simply an ammonium salt of casein and can be prepared by injecting ammonia over finely divided dry casein. The reaction is stopped when the product mostly dissolves in water. Great care should be taken in the preparation of casein as the final product, viz. encasein, is used for human consumption.

Water-resistance in casein glue is generally effected either by heat treatment of the proteins in a hot press or by coagulation with lime in the case of cold press casein. The following formula is suitable for *wet mix* water-resistant glue :

Casein	1,000 gm.
Water	2,500 gm.
Sodium hydroxide . . .	110 gm.
Calcium hydroxide . . .	200 gm.

The glue is prepared very quickly by soaking casein in part of the water, and then adding alkali dissolved in the remainder of the water. The mixture is then stirred thoroughly till the casein is dissolved. After adding the lime for a few minutes the glue is ready for use. It will have a general working life of 6 to 7 hours. This can be expected to give joints in wood working of excellent dry strength and good water-resistance.

For *dry mix* which can be sold in packets a suitable formula is :

Casein	1,000 gm.
Sodium hydroxide . . .	110 gm.
Calcium hydroxide . . .	300 gm.

The three ingredients can be ground together, packed and stored until the glue is ready for use. To prepare the glue the powder is mixed with water in the ratio of 300 gm. water per 100 gm. casein and stirred thoroughly.

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Q. Is the freezing point of skim milk different from that of whole milk? What is the accuracy in the cryoscopic determination of added water in milk ?

A. The freezing point of skim milk is not different from that of pure whole milk. With the help of the freezing point test it is possible to detect adulteration of milk with water up to 3 to 5 per cent (minimum limit).

You may also refer to the following books for further information on the above points : *The Chemistry of Milk* by W. L. Davies, 2nd edition ; *Fundamentals of Dairy Science* by Rogers *et al.*

What's doing in All-India

BOMBAY

By B. S. Patel

Principal, College of Agriculture, Poona

At a conference held at Poona on 21 May, under the chairmanship of the Director of Agriculture, the progress of the 'Grow More Food and Grow Less Cotton' campaign was noted.

Up to 12 May, 324 cultivators' meetings attended by 54,000 cultivators had been organized by the special propaganda officers and district officers of the Agricultural Department in various parts of the Central Division. Such work had been concentrated in the areas of the Division in which short and fair-stapled cotton was being extensively grown.

The ballad singer appointed for work on the campaign had proved effective and had aroused considerable interest at the meetings he attended. It was agreed that other suitable persons might be engaged for a short period to intensify the work.

For distribution to cultivators in suitable areas of the Central Division 560 bags of Akola *bajra* seed had been purchased. It was noted that certain rural development boards had given assistance in seed distribution by meeting the transport charges on seed from the areas where it could be obtained to the areas where it was required for distribution. The Conference considered that this form of assistance by rural development boards was most valuable and should, if possible, be extended throughout the whole Division.

Estimated increase of food

As a result of the propaganda campaign, the following has been estimated to be the possible reduction in cotton acreage and the probable increase in food crop production in the forthcoming year :

District	Area in thousands of acres			
	Cotton		Food Crops	
	Last year	1942-43	Last year	1942-43
East Khandesh . .	622	520	652	754
West Khandesh . .	393	310	727	810
Nasik . . .	67	60	1,381	1,388
Ahmednagar (dry tract)	140	35	1,956	2,076
Ahmednagar (canal tract)	30	8		
Sholapur (dry tract) .	56	14	1,635	1,685
Total .	1,308	947	6,351	6,785

It was decided to store some wheat seed for sowing in the next season to get over the difficulty of shortage of wheat seed.

A food production week was observed throughout the Central Division from 24 to 30 May, and 639 meetings attended by about 87,000 cultivators were organized by the various officers of the Agricultural Department in the Central Division. To make the meetings interesting, 1,000 copies of pamphlets of special ballads and songs prepared for the purpose were distributed. *Kirtan* formed a special feature of some of the meetings. These methods made the meetings attractive and greatly influenced the minds of the cultivators in favour of the campaign.

Agricultural staff mobilized

In the Southern Division also the important activity was the propaganda for more food and less cotton. Pamphlets issued by the Department were distributed to the cultivators and posters displayed even in remote villages so as to broadcast the message.

Arrangements for the supply of seed have been made, especially for poor cultivators at

the concessional rate of two-thirds of the cost, for the expansion of their normal areas under food crops. That the arrangements may be fruitful, the help of the cooperative institutions of the Division has been fully enlisted. A very good response from all other departments of the Government has also been received in the conduct of this propaganda. The outstanding feature of this activity is the successful observance of the food production week from 24 to 30 May throughout the Southern Division. All the staff, numbering 140, from the Deputy Director of Agriculture, Dharwar, down to the Field Kamagars, were engaged in conveying successfully the 'Grow More Food' message to every nook and corner of the villages in this division.

The Deputy Director of Agriculture had an opportunity of arranging and addressing an annual conference of representatives (about 225 and 75 visitors) of the village panchayats in the Karnatak at their conference held at Belgaum. He also addressed a very large meeting of the cultivators and landholders, presided over by Sir S. T. Kambli, and cleared up some doubtful points on the subject.

Every officer was allotted a definite and reasonably sufficient area in which he was to concentrate his activities and carry on propaganda. Each officer held about 14 meetings during the week in important villages in the area allotted to him.

What villagers are to do

The programme consisted of morning parades of schoolboys and village children with attractive and effective slogans. Meetings of cultivators were held in every village. The following procedure was followed at these meetings.

(1) The necessity of growing more food crops and the crops which can be grown with special reference to the tract was explained.

(2) It was shown by facts and figures that under the present circumstances crops like wheat, *jowar*, etc. are better than cotton in their relative money returns.

(3) The difficulties, which the cultivator would have to encounter by growing non-food crops, especially short and fair-stapled cotton and tobacco, such as unfavourable prices, transport difficulties, etc., were explained.

(4) The arrangements for the supply of seed were explained.

(5) All the leaflets and press notes on the subject issued by the Department and Government were read and explained and they were distributed to the cultivators.

Prominent feature of this propaganda was the village committees formed for the furtherance of effective work in every village. The estimated increase in area was above 5 per cent in every case. The total number of meetings held was 1,246 and the total attendance of cultivators was 133,828.

SIND

By L. M. Hira

Senior Marketing Officer, Sind

THERE are two and a half lakhs of acres under *desi* cotton in Sind, mostly in Lower and Middle Sind. Out of this, one lakh is to be utilized hereafter for growing food.

The Government propose enforcing the Cotton Control Act in the two zones in order to prohibit the cultivation of *desi* cotton altogether. *Desi* cotton-growers have been warned that there is no market for their produce.

The position as regards the production of the principal food crops in Sind is as under:

	Area in 1940-41	Production	Consumption
	(acres)	(tons)	(tons)
Rice . .	1,420,000	360,000	293,000
Wheat . .	1,203,000	500,000	350,000
Jowar-bajra .	1,206,000	160,000	14,000
Gram . .	389,000	45,000	61,000
Crops other than cotton .	921,000	..	..

On the basis of these figures, we have a surplus of about 100,000 tons of rice and 150,000 tons of wheat. This does not mean that we can afford to relax in our efforts to grow more food crops. Our task, therefore, is to ensure that this surplus is turned to the best account.

The food campaign

In order to increase the area under food grains in the *kharif* season, the following orders have been issued by the Sind Government. The orders apply to *kharif* 1942 only. *For Barrage Canals :* (*a*) Extra water will be given by means of pipes to zemindars who wish to grow *jowar* and *bajra.* Zemindars should apply to the Executive Engineers of their divisions for extra water. (*b*) As much water as possible over and above the supply of 1942 will be admitted into the rice canal, and distributaries and minors will flow slightly above full supply level, where there is no possibility of breaches. *For Inundation Canals :* (*a*) Canals will be opened earlier than usual if zemindars desire it. (*b*) As much water as they can safely carry will be admitted into inundation canals during July and August. The July water will help the transplantation of rice and the August water will be used for *bosi rabi.* (*c*) Certain canals have very favourable heads on the right bank of the Indus in Upper Sind, and usually carry more than their designed discharge. These canals are the Desert, Begari and Sind canals, and some of the smaller canals along the Sukkur-Begari *bund.* On these canals extra water will be allowed into *karias* (water channels) on which the intensity is not already high. On these same canals rice restriction will be removed from *kabuli* lands; in the case of *karias* on which there is a number of partners rice restriction will be removed, provided all the partners agree to the removal. (*d*) On the Fuleli canal and the Daryahi canals in the Tando Division rice restriction will be removed on *karias* on which all the land belongs to only one zemindar.

The Government has also sanctioned a further grant of Rs. 1,85,600 to be added to the original grant of Rs. 3,59,400 for distribution of pure seed of *jowar*, *bajra* and rice with a view to encouraging cultivation of such crops. Wheat, barley and gram will also be grown in larger quantities during the *rabi* season.

The Agricultural Department has launched a 'Grow More Food' campaign throughout Sind and vigorous propaganda through its district and publicity staff is being carried on.

The Premier himself is carrying on propaganda for the food production drive.

Plans for reduction of *desi* cotton and increase of food crops are being put into effect on all Government farms in Sind. The Horticulturist has been asked to increase the cultivation of quick-growing fruits like papayas and bananas on the Fruit Farm, Mirpurkhas, and the Willingdon Cattle Farm.

The above are only some of the measures taken in connection with the campaign.

Provincial Marketing Board

The first meeting of the Provincial Marketing Board was held at Karachi on 15 April. Several problems relating to marketing such as the establishment of grading stations, regulation of markets and market charges, weights and measures, the food production drive, cooperative marketing were discussed.

His Excellency the Governor was pleased to send the following message: 'At a time when the course of the war has curtailed, and may well curtail still further, foreign markets for agricultural produce, the problem of good marketing for a food-surplus province such as Sind assumes greater importance than ever before. Our task is to ensure that this surplus is turned to the best account, and the members of the Board have a heavy responsibility for seeing that my Government is furnished with the best possible technical advice for the conservation, improvement and distribution of our food supplies. Once a producer is sure of his market, he can be readily encouraged to reach and maintain a high and uniform standard of produce; this in its turn will result in increased demand for high-standard, graded goods by the consumer. At present in Karachi the demand for eggs, poultry, vegetables and fruit of reliable quality far exceeds

the supply, and there is room for great development in this direction. We must aim at making both producers and consumers Agmark-conscious, and I look forward to the day when it will be possible, as Persians say, 'to buy peas without first prodding the sack'. I note with satisfaction that your Board will direct its attention *inter alia* to the encouragement of cooperative marketing—one of the best means of helping the small producer—and that it will assist in the marketing of cottage industry products.'

The Hon'ble Rao Sahib Gokaldas Mevaldas, Minister for Agriculture, in his opening address, said : 'We have to play our part in helping to make up the food shortage in other parts of India. I would particularly request you to help the country to grow more food crops, *jowar* and *bajra*, during the coming *kharif* season in places where *desi* cotton is at present grown, i.e. Nawabshah district and also in other areas of the non-Barrage zone. Similarly, we should do our best to produce more rice and gram grown as *dubari* after rice. You need no reminder that agriculture is the basic industry of this province and the producer is entitled to reasonable profits. In order to achieve this end we must have a comprehensive survey of the existing system of marketing and then we must initiate necessary improvements. The marketing staff have so far carried out surveys of more than 30 commodities and started development work to advise the producer how best to grade his produce in order to obtain better prices.'

BALUCHISTAN

By Nazeer Ahmed Janjua, M.Sc. (Hons.)

Entomologist, Department of Agriculture, Baluchistan

SEVERE drought conditions have been prevailing throughout Baluchistan during the past three years. Great relief was, however, felt when there was enough rain and snow during January and February to enable the zemindars to utilize their land in the hilly tracts for dry farming, the chief crops being wheat and barley. Ordinarily the sowing of these crops is over by about the middle of December, but this year it continued till about the end of February.

In the fruit-growing tracts of the province, general cultural operations carried out during winter are ploughing, digging of land, plantation, pruning and spraying of trees, manuring, raising of nurseries, etc. As regards pruning and spraying, there is general apathy among growers, but persistent demonstrations given every year by the Agricultural Department are bringing home to them the utility of these operations.

Improved nurseries

There were very few private nurseries formerly and those too were in a very primitive condition. Due to the constant propaganda of the Agricultural Department, quite a number of improved nurseries have sprung up, particularly in Kuchlak and Gulistan. Great improvement in the layout of the newly planted orchards is also noticeable.

The peach varieties imported from California, which have done well under our conditions, are being introduced. Apart from their distribution among the growers, a few acres of land are being put under these varieties at the Woodcock Spinny and the vicinity of the Quetta Sanatorium.

Fruit products prepared in the Canning and Fruit Preservation Research Laboratory were sent to the Fruits and Fruit Products Exhibition, Bengal, in January 1942. The canned fruits were awarded a first-class certificate of

merit and a silver medal. Almost all the products prepared have been very well received in the open market. The present stock of about 10,000 cans of different kinds of fruit has also been sold out.

Due to the war, the supply of seed-potatoes has become an acute problem. Baluchistan, however, offers great scope as a nursery for seed-potatoes. It has been decided by the Baluchistan Administration to raise seed-potatoes, and accordingly this season every effort is being made to bring more land under this valuable crop. Arrangements are being made by the Agricultural Department to purchase larger quantities of seed-potatoes and distribute them to zemindars on favourable terms.

Locust trouble

The locust situation in Baluchistan was serious. Numerous swarms continued to enter Zhob, Loralai, and Sibi districts. They moved in series of waves throughout December 1941 and January 1942 but subsided by the end of February. Loralai district was worst affected and in this Circle as many as 900 md. of locusts were purchased in the first week of February alone. Due to cold, it was very easy to catch the insects, especially in the morning and evening. From December to February, about 1,600 md. of locusts were purchased throughout the province. The anti-locust scheme for Baluchistan has been extended by the Government of India for another year. We are fully prepared to meet the menace in case there is a spring breeding in this province.

The annual Horse and Cattle Show was held at Sibi in February. Horses, bulls, bullocks and camels were exhibited and prizes were given to the best breeders in the province. A similar show was held at Usta in the Nasirabad Colony of the Sibi district in the same month and along with it an agricultural show was also held. Improved varieties of seeds and implements were exhibited and their usefulness was explained to a large gathering of zemindars. The usual ploughing competition created much interest.

MYSORE

By M. Vasudevamurthy, B.Ag.

Secretary, Mysore Agricultural and Experimental Union, Bangalore

An outstanding event was the Southern Region Cattle Show held at Bangalore. It was a unique occasion as representative animals of several South Indian breeds were gathered for the benefit of local lovers of cattle. Milch cattle were as prominently displayed as draught cattle. A fitting climax was the distribution of prizes by His Highness the Maharaja. The best Deoni animal received the cup donated by His Exalted Highness the Nizam of Hyderabad, and the best Hallikar animal that donated by His Highness the Maharaja of Mysore.

A sheep show was also arranged and part of the grounds was occupied as well by the All-India Poultry Show. These shows also were brilliantly put up and were very educative.

The Food Front

The drive for increased food production is the topic of the day. 'The war is being fought on many fronts,' said the Dewan in a speech at the University Union, Bangalore, 'and in a country like England the Food Front, as it has been called, is one that affects vitally the well-being and the very existence of the nation. There has been a tremendous ploughing campaign in progress from the time war began, and it has been computed that the arable acreage has increased by about four millions since then. In our own country schemes

designed to encourage educated young men to take to agriculture as their occupation are a well-understood means of minimizing the effects of unemployment in normal times. In times such as these, when there is great need for increasing the supply of foodstuffs, colonization schemes have an added value. The agricultural colonies we have started have yielded results which are on the whole very encouraging. But there is still vast scope for young men to take to agriculture. There is a lot of irrigable land awaiting cultivation. The capital required is moderate and a part of it is advanced by the Government. If we had more educated men coming forward to live in the villages and take to agricultural pursuits, the colonization scheme might well be expanded. It may not be generally known that we in Mysore are by no means self-sufficient in the matter of production of foodstuffs. We import rice to the value of nearly Rs. 100 lakhs a year. If you take rice, cotton, and pulses together, the deficit is as much as Rs. 3 crores. On the other hand, there is a large extent of cultivable land, including irrigable land, lying fallow. This land must be cultivated and cultivated intensively and intelligently. There is a whole field therefore for young men with a rural bias to make a career for themselves, perhaps only a modest career, and incidentally render a service to the state of no small significance.'

Cotton Control Act

The extension of cotton in the Malavalli area and the establishment of a ginning factory at Maddur have been mentioned previously.[1] While the scheme is progressing, a Cotton Control Act has been passed with the object of maintaining the quality and reputation of the cotton grown in particular parts of the state. The Act provides for prohibition or regulation of cultivation of specified varieties of cotton in notified areas for such period as may be deemed fit. Possession, use, and mixing of different kinds of cotton are controlled and trade in inferior cotton is restricted. Import of specific varieties of cotton in quantities of more than 10 lb. and erection of ginning and pressing factories are subject to licence. The varieties of cotton and the zone from which cotton may be ginned in the factory may also be fixed by the licence.

[1] INDIAN FARMING, Vol. III, No. 1, p. 43.

Anti-malaria campaign

Agricultural development under irrigation is handicapped by malaria. The problem has come before the Government. A sum of Rs. 8 lakhs has been sanctioned for anti-malaria engineering works in the Irwin Canal area during 1941-42. A modified arrangement for irrigation has been enforced to give a chance for a whole area under each distributary to dry up in the summer months in two out of three years of the triennial system.

Another effect of irrigation is the increase in liver-fluke which has proved to be a menace to sheep around Mandya. This trouble has been investigated and suitable remedies including duck-farming are being worked out.

Marketing

According to the report on Cooperative Societies in Mysore for 1940-41, there were 14 marketing societies during the year for the sale of figs, paddy, bananas, oranges, potatoes, ginger, eggs, coconut and copra, honey and wax, cardamom, sugarcane, jaggery and areca. Progress is also indicated by increase in membership, paid-up share capital and volume of business handled as in the case of the Malnad Areca Marketing Society, which sold 29,369 md. of areca during 1940-41 as against 8,920 md. in the previous year.

Grading and sorting, well known in the coffee and tobacco industries, have been applied to a number of other products through the efforts of the Marketing Department. Eggs and oranges specially have been handled at several centres. In the case of oranges it is reported that grading resulted in an increased return by 17 to 20 per cent.

In the line of processing such as might have an effect on local production, the report of the Marketing Section introduces a new item, namely dehydrated potatoes. Work in this regard is stated to be progressing in response to war demand. It is also reported that local samples were approved by the Foodstuffs Directorate, Government of India, and

the Marketing Department is trying to see that required facilities are afforded to local manufacturers.

The market news service instituted by the Marketing Department is an interesting experiment. A few of the figures in the price lists obtained through the courtesy of the Chief Marketing Officer pertain to fruits like bananas, oranges, limes and apples. This is a useful addition to the information commonly obtainable and is likely to draw the attention of the public to this set of nutritionally important commodities, more and more as the market news service becomes popular.

The Month's Clip

VEGETABLE SEED IN CANADA

VEGETABLE seed growing in Canada has become well established as an industry and is making a fine contribution toward providing against a shortage of seed, all the important kinds of vegetables being produced in varying amounts to meet the needs. The production can be easily stepped up, should fair warning be given, states T. F. Ritchie, Division of Horticulture, Central Experimental Farm, Ottawa.

During wartime at least it is necessary to be certain of having plenty of seed of the most essential kinds and varieties, disregarding the less important ones. This is the idea underlying the programme of production now under way, with such seed crops as bean, beet, cabbage, carrot, cauliflower, corn, cucumber lettuce, onion, parsnip, peas of the garden and canning types, radish, spinach, swede turnip, squash and tomato.

Canada has taken the lead in the production of registered vegetable seed and growers report that they are well satisfied. This industry can be expanded to a much greater extent if Canadian gardeners insist on being supplied with registered Canadian-grown seed. One of the advantages of registration is that these good strains are perpetuated under inspection and carried from generation to generation, thus insuring uniformity of type, quality and performance. The stock seed from which most of these good strains come has been the result of many years of breeding and selection work carried on by the technical workers at several of the Dominion Experimental Farms and Stations and other institutions.—*Press Note, Department of Agriculture, Canada.*

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INOCULATE SOYBEAN SEED

AN increasing demand for high protein feed and vegetable oil is expected to advance the 1942 acreage sown to soybeans in Ontario. Many farms will probably be growing soybeans this year for the first time. Where this crop is new to the farm, the necessity for proper inoculation of the seed before planting is exceedingly important, says C. W. Owen, Dominion Experimental Station, Harrow, Ont.

The soybean plant is a legume and like other legumes gathers nitrogen from the air, which is stored in the roots. It is both desirable and economical to obtain as much atmospheric nitrogen as possible to relieve the demands made upon soil nitrogen supplies.

The medium through which this atmospheric nitrogen is obtained and made available to the plant is bacterial. When present in the soil these bacteria multiply on the roots of the soybean plant and form pealike bodies called nodules. These nodules are visible to the naked eye, and when present are proof of successful inoculation. If nodules are not present in abundance, inoculation has not been successful, and the full advantages of a legume crop are not being realized. The fact that soil has been inoculated for clover or alfalfa is of no value to the soybean crop. The bacteria which form nodules on soybeans are different from all other legumes and only soybean nitro-culture will be effective on this crop.

Soybean seed should be inoculated before planting. Cultures for inoculating soybean seed may be obtained from most commercial seed houses in Canada. Simple directions for using cultures are provided by the manufacturers. It is important to prevent inoculated seed from coming in direct contact with sunlight as far as possible.

When soybean crops show a tendency to become pale and yellowish in midsummer, poor inoculation may be the cause. In any case it is a wise procedure to pull up carefully a few plants in each crop and examine the roots for nodules. Inoculation of a field will generally last for several seasons, but considering the small labour and expense involved in this operation in comparison to the benefits derived, frequent periodic inoculations will be found

advisable.—*Press Note, Department of Agriculture, Canada.*

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FEEDS FOR FERTILITY

THE modern methods of poultry management have brought out many problems which were not met with before. Not the least of these is how to obtain as many healthy chicks as possible from a given number of eggs. Earlier hatching, forcing for higher production, and crowding have all tended to lower the hatchability of eggs as compared with more natural methods.

In the light of present knowledge gathered from research work at several institutions, it is now well established that the hatching qualities of eggs depend principally upon some recently discovered factors in feeds. It has been found that, even after all the requirements of health and ordinary egg production have been met, there are still lacking some factors required for high hatchability. These factors are known as vitamins. It is sufficient to say that these vitamins are found in practically all feeds, but in larger amounts in such feeds as fish oils, milk, yeasts and dehydrated green grass, says T. C. Chiasson, Dominion Experimental Station, Fredericton, N.B.

Experiments designed to discover the most efficient feeds for hatchability have been conducted at the Fredericton Station for a number of years. Cod liver oil was found to give good results many years ago. As this is now added to the regular laying mash there is no need further to emphasize its need. It is usually added to the mash at the rate of 2 per cent by weight.

During more recent years several feeds have been found very efficient in increasing hatchability. Dried milk has been found to be the most efficient feed for this purpose, but it is rather expensive. Dehydrated alfalfa leaf meal and cereal grass have also been found to increase hatchability to a considerable degree. For instance, the addition of 4 per cent cereal grass and 8 per cent dehydrated alfalfa gave increases in the total number of eggs hatched of 18·35 per cent and 18·38 per cent respectively over the check ration. The check ration did not contain any powdered milk, but was a well-balanced laying ration including cod liver oil, the protein being furnished by meat meal and fish meal.

To summarize these results, it seems as if the inclusion of both powdered milk and dehydrated alfalfa or cereal grass in the hatching ration will give the most satisfactory results. The hatching ration fed at the Fredericton Experimental Station now contains about 10 per cent powdered milk and 5 per cent dehydrated alfalfa. These amounts being small, they will only increase the cost of 100 eggs by a few cents. This cost, when compared to the value of 18 or so more chickens from the same 100 eggs, seems like a very good investment. Aside from the financial returns involved, this is also a patriotic thing to do because Britain wants more eggs.—*Press Note, Department of Agriculture, Canada.*

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HISTORY OF THE TURKEY

ALL varieties of the domestic turkey originated from the wild breed in northern America where the earliest settlers found it roaming wild in large numbers. As can be expected, the breed received a measure of protection and to this day smaller numbers may still be found in the wild state in remote parts of that country.

It is believed that two varieties of wild turkeys were found in the more northern parts of America and Canada and in the southern states and Mexico. In Honduras and Central America, a second species was found, known as the Oscellated turkey. It was stated that this variety had no breast tuft and surpassed the other by its iridescent splendour of colour. Although naturalists prefer to class it as a species different from the others, as poultrymen use the technical terms, turkeys are all of one species and, strictly speaking, of one breed, but of many varieties. It is therefore evident that all the different turkey varieties spring from the original wild American stock, selective breeding and difference in climatic conditions and environment having been largely responsible for the presence of the many colours and types of today. This no one questions and it corresponds with the history of the domestic hen.

In about the year 1500 the Spaniards took birds from Mexico across the Atlantic Ocean and domesticated them in the Spanish Peninsula, whence they spread over Europe. In about 1550 turkeys were first introduced into England.

It is interesting to note that prior to this period the peafowl (peacock) played the same role in the Christmas menu in England as the turkey does today.

In the years 1656 and 1657 turkeys and swans were first introduced into South Africa from Holland. These birds were sent to Jan van Riebeck at Cape Town by the Dutch East India Company, chiefly for the purpose of sending some of their progeny to Batavia and India to be used there as curious presents in the interests of the Company.

It is therefore reasonable to assume that the earliest settlers in the Cape obtained and bred some of these birds, and in this way, as the settlers moved inland, turkeys became established in South Africa.—E. F. LOMBARD, *Farming in South Africa*, January 1942.

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CULTIVATING THE TOBACCO CROP

THE amount of cultivation given to the tobacco crop depends on the kind of soil on which the crop is grown, and on seasonal conditions. Experiments on Dominion Experimental Stations conducting tobacco investigations have shown that the primary purpose of cultivation is the control of weeds, although on heavier soils improved moisture relations and tilth are also important, says Dr N. T. Nelson, Chief, Tobacco Division, Central Experimental Farm, Ottawa.

It is particularly important on the light, sandy flue-cured tobacco soils that the grower should exercise care in not overdoing the amount of cultivation. Physical condition and tilth are minor considerations on these soils, for as a rule they are easily kept loose and open. The maintenance of soil organic matter has been found to be a major factor in producing good yields and high quality of flue-cured tobacco. Laboratory tests have shown that excessive cultivation tends to reduce the amount of active, readily decomposible organic matter of these light soils.

The important thing in cultivating is to prevent the growth of weeds, which if allowed to grow sap the moisture and fertility from the soil required by the tobacco crop. In this way judicious cultivation increases the efficiency of soil moisture and indirectly conserves it for crop use. Unnecessary cultivation, however, should be avoided on light soils.

Light flue-cured tobacco soils usually require only three or four shallow cultivations to control weeds during the season. Heavier burley, dark and cigar tobacco soils, or poorly drained fields may need an extra cultivation to maintain good tilth. Care should be taken to avoid cutting the plant roots by too deep cultivation, especially at the last cultivation. Late season weed control is best accomplished with a hand hoe, thus reducing the possibility of spreading mosaic and cutting the tobacco roots. The first cultivation after establishing a stand should be the deepest and most thorough.—*Press Note, Department of Agriculture, Canada.*

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CONTROL OF ALKALI

THE problem of alkali is encountered in comparatively few areas where intensive agriculture is practised. In eastern Canada the problem is more likely to be one of acidity than of alkalinity, and the same holds true on the Pacific Coast. In other areas of the province, however, land is being lost to cultivation as a result of the excessive concentration of alkaline salts. This holds true in some parts of the Okanagan Valley in British Columbia.

Pioneer work on the control of alkali has been done in California, Utah and Hungary. Other parts of the world have also helped to improve the control methods. In the Okanagan Valley a number of experiments have been conducted to determine the effectiveness of the control methods recommended in other countries. As a result of experiments the following recommendations are now being made by the Dominion Experimental Station at Summerland, B. C.

(1) Some attempt should be made by growers on the higher levels to refrain from irrigating any longer than necessary at each application,

so that the lower levels will not receive so much seepage water. Care should also be taken to prevent leaks in flumes and ditches. Seepage water not only prevents soil aeration, but also carries alkaline materials with it.

(2) If the condition is still aggravated by seepage, it may become necessary to install a drainage system. This is especially true where the subsoil is impermeable. Without good percolation of irrigation water down through the subsoil it is difficult to control alkali.

(3) Apply gypsum at the rate of three to five tons per acre. This supplies the necessary calcium in a fairly soluble form, and at the same time counteracts the alkaline condition. Application is preferably made in the fall. The one application should be sufficient for several years.

(4) In the spring leach heavily, that is, make an especially heavy application of irrigation water. This serves both to carry the harmful sodium out of the soil and to carry the calcium in. Each of the subsequent irrigations will help to accomplish the same purpose until by the end of a year a fairly definite improvement should be in evidence.

(5) If the soil is tight, it may be opened up somewhat by a crop of sweet clover, which is comparatively tolerant to alkali. Alfalfa, though less tolerant, is better still where it can be grown. Roots of alfalfa that have been allowed to grow down for three or four years work wonders in the opening up of a heavy soil.—*Press Note, Dominion Department of Agriculture, Canada.*

New Books and Reviews

Ducks and Geese

By H. M. Lamon and R. R. Slocum (Orange Judd Publishing Co., 1940, pp. 232, $ 2.00)

THIS publication is intended primarily to serve as a guide to those who are interested in the rearing of ducks and geese which is a unique enterprise in that it lends itself to the greatest degree of specialization and intensification along purely commercial lines. It supplies valuable information on ducks and geese as complete and clear as possible. Five out of eight chapters of the first part of the book are devoted to the commercial aspect of duck husbandry and the second part, containing six chapters, deals entirely with geese rearing. More than eleven standard varieties of ducks and six varieties of geese, popular in America, have been fully described, explaining the physical characters, habits, feeding, breeding, housing, handling, fattening, marketing and management of ducks and geese. Methods employed by successful commercial raisers have been incorporated and much space has been allotted to the operational aspect of large-scale duck raising. The fact that a great proportion of ducks entering into the trade in the United States is the product of small flocks raised on general farms has not been overlooked and a chapter has been specially added, dealing with ducks raised on the farm. It has also been hinted that most of the information given for the benefit of the commercial raiser can be readily adapted to use in connection with small flocks. This valuable piece of work fills a gap in the series of useful contributions in the branch of poultry husbandry and it provides ample elucidation as to how ducks and geese rearing can be made to serve as a profitable enterprise for commercial breeders and mixed farmers.

In India ducks and geese do not occupy any place of importance on the farm, but ducks' eggs enjoy nearly as broad a market as the hens' eggs. This fact offers a great opportunity for developing a lucrative industry in the marketing of ducks' eggs for profit. The different methods of picking and treating feathers which constitute an important item of industry in the United States have been described. The book is attractive and profusely illustrated and should find a place in the library of all lovers of animals.--[S. K. S.]

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We Weave to Victory

(Issued by the U. P. Cooperative Industrial Federation, Lucknow, 1942)

HOW the U. P. Cooperative Industrial Federation mobilized the rural workers for the war effort is described in attractive pictures in this little brochure which comes as a reminder that the rural craftsman is just as important as the mill worker in the manufacture of modern munitions. Sir Maurice Hallett, Governor of the United Provinces, who writes a message, speaks in appreciative terms of the village cooperative industries of his province which on the one hand are helping to win the war and on the other, 'have seized the opportunity afforded by a wartime demand to establish themselves to bring benefit to many thousands of village people'.

War supplies opened a vast field for cooperative organizations, new and old. A great variety of articles were required by the Defence Department and a good number of them were capable of being manufactured by cottage workers or petty producers. Materials such as army blankets, knitted goods, camouflage nets, towels, gauze and brushes may be mentioned. The U. P. Cooperative Industrial Federation has been able to put the Defence Department in direct touch with the primary producers and save the middleman's profit as well as exploitation by the unscrupulous contractor who deliberately reduces the quality in order to make the most of a contract. The brochure emphasizes the fact that whenever supply work was undertaken by cooperative societies the quality of the goods supplied has invariably improved.

The example of *tat-pattis* is given with suitable illustrations. In November 1940 deterioration in hemp *tat-pattis*, used for making various tent components, was noticed by the Indian Stores Department. The help of the cooperative societies was sought. Antu, a village in Partabgarh district in Oudh, was the chief centre for hemp products. The District Bank, Partabgarh, started a campaign for the production of goods of the specified quality and within six weeks *tat-patti* components valued at Rs. 40,000 were supplied and further contracts for nearly Rs. 1½ lakhs were secured. About a thousand village families were benefited by the work. Orders poured in for other materials such as socks, drawers, water-bottle carriers, tapes, *niwar*, gauze, camouflage nets, pith hats. The scope of the enterprise may be gauged from the fact that camouflage nets alone have brought to the villages in the United Provinces over Rs. 7 lakhs in three months.—(F. M. de M.)

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International Journal of Agrarian Affairs

Vol. I, No. 1, October 1939 (Oxford University Press, 3*s*. 6*d*.)

AGRICULTURAL economics is pre-eminently a subject for discussion on an international scale. This journal with which Mr L. M. Elmhirst, President of the International Conference of Agricultural Economists, is associated was brought out on the eve of the war and a review copy reached us recently. It is unlikely that under the present disturbed conditions a journal like this can flourish; but its subject-matter is of exceptional interest and is bound to attract attention. The first issue is devoted to the problem of surplus agricultural population which is discussed by writers from the United States, Great Britain, Canada, Bulgaria and Latvia. The problem is of special interest for India and may perhaps be discussed at a future date with reference to Indian conditions.

What is the problem of surplus agricultural population? Bulgaria has 80 per cent of its population dependent on agriculture and less than 20 per cent in other occupations. The United States of America has only about 20 per cent in agriculture, while other occupations provide opportunity for 80 per cent of the population. Bulgaria has 116 agricultural people per 100 hectares cultivated land as compared with 17 per 100 hectares in the United States of America. But both the countries have a problem of surplus agricultural population! How a similar problem can exist under very different circumstances provides scope for economic analysis, and an illuminating discussion of the subject is presented in this first number.

It is to be hoped that with the return of peace this journal will once again provide a forum for the widest possible discussion of agrarian affairs.—(F. M. de M.)

J. A. Muliyil, B.A., Ph.D.
Late Biological Control Research Officer
Imperial Agricultural Research Institute, New Delhi

PLATE 99

From All Quarters

KING'S BIRTHDAY HONOURS

THE King's Birthday Honours list includes certain names connected with service to agriculture and animal husbandry:

To be Member of the Order of the British Empire

Seth Muhammad Sarwar, Esquire, M.R.C.V.S., Director of Veterinary Services, North-West Frontier Province.

Rao Bahadur

Balakrishna Badami, Esquire, Director, Veterinary Department, His Exalted Highness the Nizam's Government, Hyderabad, Deccan.

Khan Sahib

Shaikh Jan Muhammad, Superintendent, Office of the Director of Agriculture, Punjab.

Rao Sahib

Sri Muniswamy Ponnayya, District Veterinary Officer, Coimbatore Circle, Madras.

Jagannath Sakharam Gurjar, Esquire, Deputy Director of Agriculture (Officiating), Western Circle, Amraoti, Central Provinces and Berar.

Maganlal Lakshmidas Patel, Esquire, M.Ag., Cotton Breeder, Southern Mahratta Country, Dharwar, Bombay.

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TWO-YEAR-OLD MOTHER

THE interesting case of a calf becoming a mother at the age of 22 months has been reported by a private breeder in Coorg. She is Marionette, a crossbred (Ayrshire-Sindhi) female calf, whose mother (Cow No. 309, Marina) was bought from the Imperial Dairy Institute, Bangalore. The calf was born and bred on the breeder's estate, and from her birth she was fed on a standard ration with a little extra ration of *ragi* and broken rice gruel. She appeared rather big for her age but in other respects she was quite normal and healthy. When she was barely 13 months old, the calf was accidentally served and after 9 months gave birth to a female calf. Both the mother and the calf look well and are reported to be progressing satisfactorily. Some particulars regarding this remarkable young mother are given below:

Name	Marionette
Born	19 May 1940
Served . . .	20 June 1941
Calved . . .	23 March 1942 (female calf)
Weight of calf . .	56 lb. (on 3 April 1942)
Height of calf . .	25 in.
Height of the mother, i.e. Marionette	52 in.
Milk yield . . .	6 seers (by milking only two teats as two teats are left for the calf), i.e. 12 seers approximately per diem

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DR. J. A. MULIYIL

IT is with deep regret that we record the death of Dr J. A. Muliyil at the King George V Medical Hospitals, Vizagapatam, after a period of prolonged illness. By his death India has lost one of her ablest senior workers in the field of applied entomology.

Born in British Malabar in 1891, Dr Muliyil was educated in the Madras Christian College from where he graduated in 1915 with zoology as his main subject. He soon joined the Entomology Section of the Madras Department of Agriculture as a Research Assistant and it was not very long before he made a mark in the Department by dint of sheer hard work as a research worker. In 1934 he joined Trinity College, Dublin, for postgraduate studies and worked under Dr Gatenby. He was awarded the degree of Doctor of Natural Philosophy of the Dublin University in 1936. On his return to India he was appointed Lecturer in Entomology in the Agricultural College at Coimbatore. In 1938 he joined the Imperial Agricultural Research Institute, New Delhi, as Biological

Control Research Officer in the scheme for research on insect pests of sugarcane of the Imperial Council of Agricultural Research.

While at Madras, Dr Muliyil was closely associated with the control of the *pollu* beetle and the biological control of *Nephantis serinopa*, a very serious pest of the coconut palms that fringe the coast of Malabar. In the Imperial Agricultural Research Institute at New Delhi, Dr Muliyil made a critical study of the promising parasites and predators of sugarcane pests in India with a view to their introduction and establishment in other sugarcane areas in the country. Dr Muliyil tried mass-scale liberations of *Trichogramma minutum* for three years in Bihar to assess the usefulness or otherwise of this important egg parasite of cane borers. He had planned to continue the experiment for two years more to get conclusive results but did not live to see the fruition of his endeavour.

Dr Muliyil was a devout Christian and his perception of spiritual facts was intense. To him Christianity was not a narrow creed but an ever-widening field for service and love. He possessed the most important of the Goethean Absolutes, goodness, in abundant measure and was always kind and considerate to everyone who came in contact with him. The Agricultural Department lost an efficient and conscientious officer and his friends a genial and lovable companion.—(E. S. N.)

MGIPC—M—III-1-34—14-8-42—2,000.